Lectures on Industrial Administration

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(*Delivered at Cambridge, July,* 1919)

Edited by

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PREFACE

UNDER the general direction of Dr. C. S. Myers, F.R.S., Director of the Cambridge Psychological Laboratory, there was held at Cambridge, in July, 1919, a school for the study of certain industrial management problems, chiefly from the psychological point of view. The school was largely attended. Many members came direct from responsible positions in industry, and much interest was shown in the problems discussed. The present volume consists of a selection of the lectures delivered at the school.

B. MUSCIO

(Hon. Organizing Secretary of the School).

CAMBRIDGE,
Jan., 1920.

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LECTURES ON INDUSTRIAL ADMINISTRATION.

PART I.

LECTURE I.

Some Ethical Aspects of Industry

By PROFESSOR W. R. SORLEY,
LITT.D., F.B.A., LL.D.

IN speaking to this meeting,* I feel like an outsider who has strayed into a group of specialists, an amateur among experts. Your discussions have been scientific and technical; my contribution must have the appearance of a series of platitudes—of truths with which all are familiar, and which are only overlooked (if they are overlooked) because they are so obvious. Just this must be my defence. Truths may be neglected owing to their very familiarity; and yet they may be important as well as true. Scientific study depends on analysis and needs concentration of mind on details. Yet the interest of these details lies in their relation to human knowledge or to human

1—(1726) *See Preface.

life as a whole; and the part should be seen in the light of the whole.

This is true of every department of enquiry. It is most plainly true of all enquiries into industrial matters: for they are very complicated, and yet they all proceed from something very simple and fundamental. Industry is the name for the human processes by which material things are made subservient to the creation of values: that is to say, to the production of something which is, or which is supposed to be, of worth to men. Here, therefore, we are already face to face with something fundamental, and presupposed in every industrial enquiry however minute and technical: of something, too, which, if not simple, yet always points back to this one idea of value.

Industrial processes and the attendant industrial order have two aspects, which may be called external and internal. The external aspect is mainly that of machinery, or of machinery together with the raw material supplied by the environment. The internal aspect is that of the human minds engaged in the processes and of their organisation. The latter aspect has never been entirely neglected; but it has not received the same amount of attention as the external aspect or been studied with the same scientific thoroughness. The lectures and classes of this meeting have attempted to right the balance and to study the industrial mind with the same care and as scientifically as industrial machinery has been studied.

But the internal aspect, as well as the external, may be considered from the limited point of view of industrial efficiency, that is to say, with respect only to the quantity and quality of the finished product.

In this case the limitation is imposed from without; for it is the material factor which prescribes it. The treatment will be psychological; but it will be psychology in the interests of material results. Now the mental process in industry is part of the mental life as a whole: it affects and is affected by the whole man—his wants, his ideas, and his ideals. And through these the psychological treatment passes into the ethical. It is chiefly because it does not take the economic factor as ultimate that the ethical treatment is larger than the merely psychological and assumes a different form. Two points of difference may be selected as fundamental. In the first place, economics has to do with values indeed, but only with such values as are embedded in material things; whereas ethics appraise these values by reference to a standard which is super-economic—the highest good for man. It is true that economists differ in the degree of rigidity with which they adhere to the distinction: for industrial facts are facts of life, and the economic aspect cannot be completely severed from the ethical without making it unreal; but the economist deals with goods which can be exchanged or passed from hand to hand, and the highest goods in life do not admit of this transference: for these he has no measure. The second point of difference is that the moralist is not, like the economist, content to ask only how industrial processes can be made most efficient: he asks also how they can be made to bring out the best which a man's mind and character are capable of.

On the first point much might be said, were it not too large a subject to enter upon here; its bearing only

can be indicated. The sole purpose of industry, we must remember, is to produce things of value. Regarded purely economically, these things must be capable of being exchanged, so that the price of the product becomes the measure of economic value. But the true or ethical value may be something which has no fixed relation to this economic value. A copy of the Bible or of Shakespeare, for instance, may have more value for life—that is, more ethical value—than a bottle of champagne, though its price may be less. Now it is conceivable that industry should be so directed as to produce material things which subserve to the greatest extent possible the higher or moral life. But neither the industrialists who direct the work, nor the economists who elaborate its theory, seem to have had that end in view; and the moralists who have taken it as their ideal have not succeeded in bringing it into living relation with the actual work of the world. The first object for which work is done is the means of living, its further object is living well. But what the nature is of this "living well," and what things contribute to it, are matters left very much to the choice of each man, who either follows the ways of his class or, more rarely, develops a fancy of his own. On what things does a man spend his money after the claims of mere living have been satisfied? These are the things which show character, and by them also character is formed. If all men sought the highest ends and were led by the purest motives, then economic facts would harmonise with moral ideals. In the last resort industrial difficulties arise out of moral deficiencies. Different men have different ideals; some have hardly any ideals—at least moral ideals—at all. The

theoretical consequence is that economics is forced to restrict itself to one aspect only of life, and that not the highest; the practical result is that, instead of industrial harmony, there is an industrial scramble: and this industrial scramble is the result of moral anarchy.

The second point referred to concerns industrial processes and the relation of the moral factors which they involve to their purely economic factors.

Here, in the first place, a false assumption has to be exposed—the assumption that some kinds of industrial work, in particular, manual labour, are beneath the dignity of a free man and therefore degrading. It is not merely that some kinds of work are more exacting or less agreeable than other kinds. That is a fact which raises some difficulties and calls for delicate adjustment in the organisation of labour. It is sometimes consciously asserted, more often unconsciously assumed, that work of certain kinds is of its own nature an evil and that, if it has to be done, its performance is the mark of a menial or servile class. The assumption is not merely an aristocratic prejudice; it affects all classes and has become a democratic complaint. It is the fallacy both of the superfine man who scorns to soil his hands and also of the socialist orator who goes about proclaiming that work is an evil to be avoided and that the only good connected with it is to restrict its hours, to limit its product and even to destroy its instruments. Now, this whole type of thought is a survival from the Graeco-Roman civilisation, which was founded on slavery. It was shared alike by the slaves and their masters. The theory was not the basis or origin of slavery. On the contrary,

the institution of slavery gave rise to the theory. The slaves were first of all set to do the hardest and most necessary work, and then the doctrine began gradually to make way that work of this sort was fit for slaves only, or (when slavery disappeared) for a menial class who did slaves' work. Thus slavery might decay or disappear as an institution, and the view of life founded upon it might still persist. The finest protest against it is to be seen in some of the monastic societies of the middle ages, when men of spiritual temper and intellectual culture devoted part of each day to manual toil and found that this work aided instead of interfering with the higher life. Moral ideals find their realisation in human life, and human life is always in contact with nature. No kind of necessary work is in itself undignified or degrading. We must look to the end and to the way in which means are adapted to the end. To make two ears of corn grow where only one grew before is a moral triumph whether it is done by driving the plough or by applying a Mendelian formula.

Reduced to its simplest terms, the purpose of industrial work is to impose values on nature. And if the values are true values and not false values, the work is dignified and moral. This is the fundamental principle; but its applications are hidden by the vast complexity of modern industry. The workman in a modern factory cannot "see the end"; he never catches sight of the finished product and knows nothing of the use to which it will be put. In this respect modern industry differs from ancient handicraft, and the difference is due to two connected developments: the ever-increasing sub-division of labour which limits one man's activity to the repetition of a short series

of muscular movements; and mechanical improvements through which man ceases to be himself a maker, and becomes only a minder of the machine which does the making.

An artist still paints a picture: the materials and methods he uses do not differ essentially to-day from what they were for the artist of two thousand years ago: and he can see his idea grow into completeness under his own hand. But no modern workman builds a steamship or a house or even makes a table. His work is limited to a fragment so small that it is without any individuality or interest: the end that crowns his work is never seen by him, and were it seen he could not recognise it as his; and so the work, the effort, alone remains, and is looked upon as mere toil to be minimised—perhaps to be shirked—as far as possible. The wage alone is tangible. Two questions, accordingly, may be asked, when this difference is admitted. In the first place, can we find, in modern conditions, any substitute for the old craftsman's pride in his work? and secondly, do the altered circumstances provide any guide for the solution of the problem of the hours of work? The first question concerns the conditions, the second has to do with the duration of labour.

On the first question, there is little to be said; but it brings out an important difference and shows that it may be possible to turn an obvious defect into a real benefit. The old carpenter might make a whole table or chair and so have a personal and artistic interest in his work. This is not so easy for the man who simply minds the machine which cuts pieces of wood into lengths or turns a chair leg. The craftsman

of an earlier age would make a whole piece of furniture; the labour expended on each part might be inspired by an idea of the whole and he could experience the pride and joy of a completed piece of work turned out by his own hands. He worked alone, and in this respect was an individualist: his inspiration and effort were thus so far selfish. The modern artisan, on the other hand, may have lost the particular form of interest and achievement enjoyed by his predecessor; but he may find compensation for the loss in a new and more social interest—in the efficient organisation of the work. "Ever strive after the whole," says Schiller, "and if thou canst not be a whole thyself, then serve as the member of a whole." Things have grown larger and more complicated. The modern worker cannot any longer be a whole or by himself complete one great and perfected piece of work; but, unable to be a whole, he can join himself to a whole; and, in so doing, not only find compensation for what he has lost, but discover a new value which was absent from the old achievement. Not only has he a hand in producing greater work than lies within the compass of a single man, but he becomes conscious that he is one of a group, co-operation takes the place of competition, he realises his social nature in his daily labour, and feels himself a part of the struggle and success which he shares with others. Of old a man had pride in his own work; now he may have pride in the common work. I do not know how often it is found; but there may be a pride of the factory, as there is a pride of the regiment. And this is a social pride, whereas the craftsman's and the artist's is, after all, a selfish pride.

For this two things are needed: knowledge not only of one's own special work but of the way in which it fits into that of others and of the whole industry; and sympathy with those others. Knowledge is often too much severed from a man's daily work. His own small function in the great machine may be easily mastered; and if he has an interest in knowledge at all, he is encouraged and inclined to seek it in subjects remote from the commonplace grind; the work is gone through only as necessary toil—a means of making possible the life he really cares for; it is only for his leisure and in his leisure that he really lives; one part of him becomes a machine in order that for the rest he may remain a man. There can be no doubt that it is well for a man to have interests of this sort, which stretch far beyond his daily routine and have no obvious connection with it. Much has been done to encourage interests of this sort by the University Extension system and other movements which have arisen out of it. They have widened the interests and brightened the lives of numbers whose minds were being dulled by monotony. They have given variety of interest to life, but they have done little or nothing to make work itself interesting. Variety has its place in life; but enough has not been done if the working hours of life are left without any idea or purpose except that of receiving wages. The dull monotony can be redeemed and pride of work restored only by some comprehension on the workman's part of the place his own individual labours has in the completed product and of the value of the product to the life of society. For this reason his education should not be divorced from his work: an important

part of it should be to show him the technical relations of his own job to that of others in the same factory and the economic position of his factory and trade in the life of the community. The view of the whole relieves the monotony of continuous labour at a part and gives stimulus to what is otherwise merely mechanical routine.

Not knowledge only, however, but sympathy also is needed in order that the common pride and interest in work may flourish. And sympathy is present in generous measure in the modern workshop and modern trade union. The misfortune is that this sympathy is limited by the horizontal divisions into which our industrial life has fallen—the divisions between the manual workers and those who plan and direct their work. The natural divisions are vertical—between one factory and another, one trade and another. Had our industrial system developed on different lines, we might have had, in competition, a rivalry of excellence instead of a struggle for spoil. But the fact that the employing and directing class has had the command of capital, and that the class of manual workers has not, has led to alienation within the unit of production—within each factory and within each trade—which has already proved disastrous to the national economy and may prove fatal. It would be out of place here to enlarge on this central feature of the industrial struggle. But it is clear that it foments misunderstanding and substitutes antipathy for sympathy; and without sympathy and understanding the world of industry will never cease from evil.

The question that remains is whether that broader treatment of industrial matters which I have called

ethical can yield any guidance on the problem of the hours of labour. I think it can; but it will be a guide only, not a solution; and the guidance it gives will not be easily translated into terms of arithmetic.

There are three different principles to which an appeal may be made for limiting the hours of labour. In the first place there is a physical limit to the number of working hours; and it is the time after which fatigue makes work impossible. In the second place there is an economic limit. It is the time after which the work either deteriorates in quality or diminishes in quantity as to make it not worth while for purely economic reasons. The diminution or deterioration may be seen immediately, or it may only take effect in the "long run"; and important results follow from this distinction; but in both cases the consideration is of a purely economic character. But there is also, in the third place, an ethical limitation; and this is the time after which the leisure left to a man is insufficient for a worthy human life, or where the toil is so great or so long continued as to blunt individual character.

The ethical limit will probably be shorter than the economic, while it is clear that both the ethical and the economic are shorter than the physical. But no exact statement can be given of the point where the ethical limit is reached. We cannot say that it is at eight hours or at seven or at any other definite figure. Nor can we say that it is the same in all trades or the same for every man. In this matter, as in others, general rules can only be reached by compromise. Nor is this compromise itself unethical. The moral life consists in a man making the best of circumstances,

not in circumstances doing the best for a man. Indeed, we must remember that, if it is really an ethical principle which we are seeking, then the ground for restricting hours of work and providing hours for leisure will depend upon how the leisure is spent. I have taught logic to a class of miners in Northumberland, and think their leisure was well-spent and their employment of it justified the limitation of their working hours. But if the leisure is spent in racing whippets and betting on the result, the reason for providing that leisure can hardly be described as ethical.

There is also another side to the shield. It is unpopular but I will venture to state it, though only in the form of two concluding aphorisms.

(1). A man should give an equivalent for what he gets. There may be difficulties in applying the principle in these days of mechanism and subdivided labour; but it is a fundamental moral law. The excellent maxim "A fair day's wage for a fair day's work" needs emphasis on the last five words as well as on the first four.

(2). Work is not bad or to be avoided because it is irksome. It is good to feel tired sometimes, though it is not good to feel tired all the time. Nothing great has been accomplished without toil.

PART II.

LECTURE II.

The Need for a Science of Industrial Administration

By J. A. Bowie, M.A.

(I).—Present Day Industry

It is always difficult to prove the need for a thing that has not previously existed. Usually we become conscious of a need only when we have lost its satisfaction. Our sense of loss is then a measure of our need. It would have been difficult for Watt or Stevenson to prove the necessity for steam power in industry before it existed. The inertia of the *status-quo* and the opposition of vested interests have always been the highwaymen on the road to progress. Therefore to prove the need for developing the science of Industrial Administration, we must point to the weaknesses of the present and endeavour to show how its application will remove them.

The present is a development from the past and like most other mushroom growths has failed to develop evenly and consistently. One hundred and sixty years would represent the age of the present industrial system and, compared with our social systems, it is

yet in its greenest youth. Our educational, ecclesiastical, military and political systems have attained the dignity of age compared with our industrial. The revolution of the methods of production beginning in 1760 supplanted the old domestic system. While it is impossible to agree with those who idealize the old it is equally impossible to deny that its conditions implied an absence of the problems and perplexities that beset the present. The old craftsman had every reason to be proud of his craft because he ministered directly to the consumer and his sense of social service was never dimmed by remoteness. He organised himself, marketed his own wares, and had the absence of that feeling of being controlled by another. He exercised in his own person the functions we have now separated between the workman, manager, employer and merchant. All that is changed, and changed for ever. It is impossible to conceive of the present population of the globe being maintained on anything like a reversion to the old system. Any suggestions in that direction can be definitely put away as simply economically impossible. Hope must lie in the proper direction, organisation, and administration of the new. Our first task then is to examine present-day industry with a view to determining its stage of development.

A wide view of British industry from the point of view of its form and outlook immediately reveals the greatest possible range of variety. No doubt industries must differ so far in form according to their economic limitations. The very conditions of some industries favour large scale production and joint stock organisation, while others are more conveniently conducted

on a small scale and by private employers. But this does not account for the great diversity of policy and outlook, because no matter what the size or form of a business, a common policy could dominate it. These differences of outlook are not accounted for by essential conditions and such differences face us at every turn. Apart from different trades and industries, if we take firms engaged in the same industry we find an enormous variation, a limitless range of design, plan, structure, and function. This variation descends, even to the details of mechanical equipment. In a recent report of the Advisory Council of the Ministry of Reconstruction on the Standardisation of Railway Equipment it was stated that on British Railways there are 200 different types of axle-boxes, that every Railway had adopted different types of tyres, springs, and axles, and that there are in use over 40 variations of the ordinary wagon hand-brake. This diversity exists also to an equal degree in the realm of business policy.

A bird's eye view of British industry presents an awkward patchwork of disconnected and ill-assorted self-sufficient units. Firms exist in every stage of development, in every stage of being and becoming—progressive firms, retrogressive firms, stagnant firms. To the onlooker it seems like a museum with exhibits ranging from historical antiquities up to what will be fifty years hence. You find trades untouched by the Industrial Revolution, the cyclone of 1760 left them care-free and undisturbed; you find 1760 factories with antiquated machinery and methods, with poorly-paid labour and long hours. Some of these even pride themselves on keeping up the old traditions. Each

stage in the evolution of the factory system has its crystallized embodiment in the industrial world of Britain to-day. Then you find a modern firm and again you find a 1950 firm—one not content with merely embodying the tried and tested developments of organisation but stretching out towards better things and cutting a pioneer's path for itself across the undiscovered country to the future. The whole wide prospect of British industry presents one with a series of specimens of industrial organizations, each preserved in its hermetically sealed compartment by the methylated spirits of human inertia and ignorance.

The reason for this museum aspect of industry is simply the ingrained narrowness and traditionalism so prevalent among the men at the helm of British industry to-day. The self-sufficiency of each unit, the all too common fallacy of " my business being unique," the jealous guard against interference, all lead to sectional thought and disjointed movement, and industry instead of presenting a single forward march like soldiers on parade, looks more, at a broad view, like the scuttling hither and thither of a holiday crowd on a railway platform. This self-centred attitude, this narrow confinement of thought to one's own business and disregard of the huge modern strides that some of the more enlightened firms in this country and many more elsewhere have made, has left British industry in a backward position from the point of view of its organisation. In England we have the huge variation due to a greater or less clinging to tradition, for industry was born here and is oldest here. More than any other country it has meant that the particular personality of its director, his stage of thought, his

eccentricities, and even his idiosyncrasies are stamped indelibly on the business he controls. As it was vividly put recently, British industry is a "riot of individuality."

Thus we find in British industry that there is no uniformity in either the practice or the principle of Administration. If you study it district by district, industry by industry, or firm by firm, you are at once struck with the peculiarly chaotic pattern it presents. If one industry can be selected more than another to demonstrate this, it is the Building industry. It may be that its economic conditions account for its peculiar characteristics. Certain it is that it is an industry which has escaped the movement towards large-scale production and that it is essentially subject to extreme booms and depressions.

Whatever be the contributory causes it is certain that there is as between different firms no settled system or method of managing. The key-note to a comparison between firms is to be found in the personality of the man at the head. As is the gardener, so is the garden, and as is the employer so is his business. At the one end of the scale you find the operative who has risen to an employer's position. Normally he is quite unfit for the task of managing, he lays exclusive stress on getting the work done and his attempts at directing are confined to becoming a sort of supernumerary foreman. It is a fact, too, that such operatives often make exceedingly bad masters. They are usually hard on their employees and are distinctly inclined to expect too much. This may perhaps account for the assertion made at a meeting of the Building Trades Parliament that "many employers are not

fit to be decent labourers." At estimating, planning ahead, employing and discharging, in ordering raw materials, and in costing and general office methods, the operative-employer is usually the merest novice, and when the subject is broached frankly declares that all such work is non-productive and therefore to be sternly discouraged. His knowledge of how his business is doing consists of a series of sporting guesses, and he has no exact knowledge of what contracts pay him, much less of what items in any contract. If you ask him he replies "I keep it all in my head." His position is quite as ridiculous as that of the captain of a sinking ship who, when approached by the terrified passengers, confesses his ignorance of detail and says he has not the slightest idea of where the leak is.

Contrast these primitive conditions with those that exist in a modern advanced factory. In the latter the various functions of management are clearly realized and they are relegated to separate experts, each responsible for his own proper function, but working in harmony with the others. There you find a Welfare Department, an Employment Department, a Planning Department, a Works Library, a Costing Department, all working in harmony to produce the maximum of efficiency with minimum of waste.

These are, of course, two extremes. It is not suggested that all businesses must be similarly systematised. Many will not carry it; but no matter how small the unit, its efficiency demands that these functions be fulfilled. Even if it be a one-man business then that one man in his own person must fulfil all the functions which a larger business can relegate to a series of distinct, though not separate, departments. To

reduce it even to its last limits, the professional man, selling only his own services, must, to be efficient exercise over his activities the same functions. His Welfare Department is his own physical fitness, his Planning Department is his time-table of engagements, his Library is too obvious a necessity to need emphasizing, his scale of fees is his Accounting. So throughout every business, whether goods or services are sold, whether it be manufacturing, conveying, retailing, commercial or professional, there is managing to be done; no matter again what the size or nature of the business, the functions of management are constant, and good management a necessary factor to success in every case.

To sum up, in every commercial or industrial enterprise good management is necessary to efficiency, and good management is one thing no matter what the size or character of the business managed. But the facts of simple observation prove that no one policy or stage, or level of management-development characterises British industry and therefore we are bound to deduce that on the whole British industry is either under-managed or mis-managed.

(II).—The Common Threads.

If we see around us thousands of diverse and contradictory ways of doing the same thing we can conclude that each is not the best. We can also conclude that there is a one best way, and it is surely the interest (and obligation if you will) of industry to discover the best way. And the only way to discover the best way is along the road that humanity has ever to tread

when faced with a new problem, the way of study and investigation. The principle seems almost self-evident. If faced with the question "Is there any need in Britain for a study and comparison of the various ways in which Employers run their businesses?" it is impossible for us to think of anyone, except perhaps a very reactionary employer, replying "No, there is no need of studying management"—the presumption being that it is perfect and incapable of improvement.

The only other objector would found his case on a statement that there was no such thing as a Science of Management; that it was a matter of expediency and common-sense and that the hundreds of different considerations and diverse circumstances encountered made it impossible to reduce the art or the practice to a set of rules or a definite system; that the variables were too many and the constants too few to solve the equation. Here you deal with materials, money and men and how they mutually act and react the one on the other and each on both, and out of this chaos of compounds it is impossible to establish general cases and particular principles.

Such a position is utterly and entirely wrong, but what it does serve to do is to emphasize the difficulty of the subject, and incidentally the very urgency of the necessity for its solution. There has never been a science but what ignorance has condemned it before its birth. It has declared it an impossibility, and often when it has struggled to its feet it has been condemned as a thing of the Devil and a Black Art. The search for the Alchemist's Stone, for the Elixir of Life and for perpetual motion has

represented the youthful stage and extravagant claims of Sciences which now we all respect. And so it may be with the movement popularly known as "Scientific Management," it may have made excessive claims and have developed lopsidedly in some directions, it may have neglected essential factors and so presented a harsh and crude doctrine to the workers. But that is of course the Black Art stage of a youthful claimant. It was an excellent thing done to death and in its operations most unscientific. It deserves most the name of "Mechanical Management." It was the pioneer attempt of a good engineer who did not fully appreciate the human factor in management. In later life he recognized his mistake and his successors have done much to correct it. To Taylor the factors on which management operated were three-fold—materials, money and human machines worked by the motive power of gain. Labour to this one-sided pioneer was just another type of machine worked not by steam or electricity but by money. Man, however, is the focus of certain sciences and whether in his work or his play he obeys the dictates of his nature. Thus his physical, mental and moral being must be considered in determining the conditions under which he labours and the sciences of physiology, psychology and ethics all have their bearing on the problem.

As to the argument that business management is a matter of common-sense and not a science the answer is obvious. First there is no separation between common-sense and science; science is organised common-sense. Common-sense alone is often extremely uncommon, In any case it varies enormously from person to person. It increases enormously in

potency when it is substantiated and justified by the synthesis of all available facts and the deducing of principles. It is then put in a solid form suitable for transport and can be carried wherever it is required, and preserved for the use of future generations. Again, the science of to-day becomes the common-sense of to-morrow. The argument that business management is mere expediency is simply an emphasis on the variety of detail it involves and acts as a stimulant rather than a deterrent to the scientific enquirer.

Every Science has its elements and the factors of production are the basic elements in the Science of how to manage them in order to produce the maximum result with the minimum waste. Labour, Capital, and Land are the three elements of the study of management in order of importance. These are the common threads which interwoven in diverse ways in the loom of management produce the whole multitudinously-patterned world of industry. The only common principle in weaving the patterns at present (when there is no agreement as to policy), is that they must be made in conformity with the modicum of industrial legislation enacted by a proverbially *laissez-faire* state. Again, under the present system they all conform to the scheme of profit-producing for the owner, else there ceases to be production.

Beyond these there are no common threads and on this meagre foundation of uniformity you have the most fantastic diversity of structure. Yet each of these primary factors can be used rightly or wrongly. In considering Land you have questions relating to site, access to transport, contour, facilities for housing, water-supply, municipal or county by-laws, proximity

to power-plant, subsoil, sewers and drains. In the matter of Buildings you have design, ventilation, grouping, lighting, heating, haulage, routing and so on. In considering the best methods of financing the business you have to take into account another large group of considerations relating to share-issues, or bank borrowings, or mortgages and bonds. You have to determine the best investment for your capital, in matter of machines and appliances, the markets for raw material and for the finished product. You have to retain control over your business by an efficient system of costing and in many cases it can be accompanied by statistical or graphical control. But perhaps the field of business which more than any other repays study is concerned with Planning. This is a wide subject and ranges from purchasing of material and tools, routing of work, instruction cards, to time, motion, and rhythm study and the effects of Fatigue. The factors more particularly concerned with labour are of ever-growing importance and need the most careful investigation. The general education of adults and more especially of the young is of vital importance to industry but is hardly within its jurisdiction. The selection of workmen, however, according to their innate abilities for particular tasks, so as to prevent misfits, is of great economic importance. Some firms have to take on three times the men they want before they get the class required. These have all to be interviewed, assigned to jobs, trained and tested and tried, and two-thirds of them are often found wanting. In the case of an agricultural implement firm employing normally 2,400, some 7,200 passed through their hands in a year. Thus 4,800 men were

discharged after trial, with a consequent enormous waste of time and materials. Then apart from selection there is the question of training, transferring and promoting. More and more betterment work is coming into prominence even from the mere point of view of a business-investment. Not that we mean to suggest that this should be the only point-of-view, for after all it is by no means certain that the chief business of life is to make a living. Then there are the hugely embarassing yet pressing questions concerned with methods of wage-payment.

No science again would be complete unless it sought to determine as distinct from the above, which we may call internal management, the true policy of what we may call social management. Which of the four parties interested in the industrial world ought to control and manage production? Ought the State in the national interests to guide and direct industry for the good of the whole? Ought the consumers of the particular commodity produced to control the industry whose products they consume? What of the workers who spend their best energy and the pleasantest part of the day-time in producing some particular commodity, ought they, whose standard of life and place in the sun is controlled by that industry, to control it in turn? Or again ought he whose money buys the round-about instruments of modern production, ought he to retain sole control of it? If not, which other, or how many others of the four, or in what proportion and with what powers ought a combination to be effected? When you determine on an innovation you have to enquire how to effect it, and how to translate without killing and how to educate up

the new determinant to his new functions and responsibilities. In answering these questions and in determining effective methods there is room for a great deal of investigation and research with a view to formulating specific principles.

(III.)—The Present Need.

Never was there a time when these problems were so pressing. Now is the testing time. The next decade will be a critical one in the history of British Industry. The nation has been bled white in the fierce European struggle, and on its cessation finds itself faced with the keen competition of two young and progressive nations that have not been similarly handicapped. America and Japan are certain to be very serious rivals in the near future. Then again, debtor nations in order to pay their indemnities must export goods to Britain. This may benefit the British consumer but will certainly tell against the home producer. These facts will not make themselves felt immediately because there are arrears of production to make up, but once normal conditions obtain the hard facts of competition must be faced. How are these to be met? The anti-dumping regulations for the protection of key-industries are intended only to prevent the unfair use of capital by selling under costs in order to oust a rival from the market. Apart from the technical difficulties and the cumulative tangle of retaliatory methods it is in any case a protection only in home markets. The competition due to greater efficiency in production will still exist and it is only by tuning up organisation that the British

manufacturer can meet it. The present time is the greatest opportunity the British employer has had since the 18th century for introducing innovations. And with characteristically British lack of foresight we have nothing prepared to meet the crying need for reform. True there are factions and sections and interests each with its hobby-horse scheme, there are reports of hurried conferences, there are the individual experiments of pioneers, there is the scurry to America in search of ideas, but nowhere have we put before us the considered collective judgment of men who have set themselves deliberately to analyse the needs of the situation. We have researched in everything except industrial management. Important as is research in every direction this is of even greater necessity; and so far in Britain it has been woefully neglected. This, as we shall see, has not been so in other countries, and much of the success of our Transatlantic rivals is due to their specialization in this direction.

To illustrate this let us take one question only out of the almost endless number that face us—the question of profit-sharing. At the present time there is both in this country and in America a revival of this old practice. It is hoped by this means to solve our labour troubles. We say advisedly "old practice" because the principle was recognized in France at the time of the Industrial Revolution and was actually applied in America in 1794. A generation ago it was revived in America and many profit-sharing schemes were launched, most of which did not stand the test of time. There were reasons for this and these reasons are fruitful lessons for the present. Yet to-day we find a multitude of firms in this country

who are prepared to lean on this broken reed. Each is seeking in its own limited way, with its own limited knowledge and opportunities to determine the one best way. Think of the tremendous re-duplication of effort and waste of energy involved and after all resulting only in crude, unenlightened decisions. For already hundreds of experiments have been tried and very little has been done in the way of collecting, analysing, adjudicating and coming to some conclusion as to the real effective service of the scheme and of the rules and principles that underlie its operation. It is not our purpose here to pursue the matter further but the following questions are suggested to show the necessity for a thorough scientific enquiry. How far is the initial success of profit-sharing due merely to its novelty? Does it promote efficiency among the employees? Does it cause dissatisfaction? What happens in the lean years? Why are higher wages so often asked in place of a bonus? Does it increase the stability of the labour force?

What applies to profit-sharing also applies with equal, if not greater force to the hundreds of other industrial problems. One exceedingly important modern movement in industry, Welfare or Betterment Work, once the scorn of scoffers, has come to stay, but in what precise form it is impossible to tell. All over the country employers are learning to call it business and not philanthropy and each employer is seeking to develop for himself the method that best meets his particular conditions. There is great need of a comparative study of the various systems already adopted by advanced firms and of some attempt to adjudicate their relative values with a view to future

guidance. Material for such a study is already abundant in this country and there are distinct signs that this movement is awakening to self-consciousness. But much remains still to be done. Until the various systems, their aims and methods, their effects on output and efficiency have been investigated each new aspirant has to learn by the slow, laborious and expensive method of trial and error. There can be no doubt that in these matters Britain has much to learn from its American rivals. But methods to be effective must be learnt with discrimination and applied with caution. It is unwise to attempt to transplant schemes from one country to another and hardly less so from one industrial unit to another even in the same country. And it is along these lines that American specialization in management problems has advanced most rapidly. In the United States to-day there are hundreds of experts who devote themselves to one single branch of the study of industrial organisation and who offer their services to individual firms as consulting specialists in that particular line. This movement is yet in its infancy in Britain. To illustrate the wide scope it embraces we mention a few of the subjects that have been definitely specialized in America. These are: the Factory Buildings, the Power Plant, Mechanical Equipment, Tools and Patterns, the Handling of Materials, Selection and Training of Workers, Direction and Control, Labour Relations, Methods of Wage-Payment, Profit-sharing, and Co-partnership Schemes, Planning, Time, Motion and Fatigue Studies, Purchasing and Storing, Advertising and Selling, Industrial Cost-finding and the Graphical and Statistical Control of Industry. Thus we see it is already clearly recog-

nized in America that the future progress of industry is bound up in the creation of a force of executives trained and educated in the principles of Industrial Administration. These principles they have already decided can be definitely taught and explained for the guidance of the uninitiated. They fully realize that the true place of management is on a level at least co-equal in dignity and importance with the so-called learned professions. And indeed it could be maintained with truth that the business administrator exercises a power infinitely greater than does any professional man, for he practically determines the conditions under which the huge mass of the people must work and live, and the great responsibility he bears combined with the intricacy of his task alike call for the highest type of practical intelligence carefully trained along the soundest lines.

(IV.)—CONCLUSION.

The case for the specific study of Industrial Administration is founded on the perplexities of the present situation, on the advantages that will accrue from the development of the Science and on the clear lead given us by our commercial rivals. The present restless state of labour is no mere after-math of war, or the midsummer madness of a bewildered proletariat, but is a real stage in the progress of democracy and must be treated as such. The questions asked require a definite answer and the formulation of such an answer means a dispassionate study of the whole problem. British industry has developed neither consistently nor progressively due to the fact that

free-play has been granted to a type of individuality not always great enough to bear the responsibilities with which it was entrusted. Combined with this there has developed from a monastic origin an educational system which has sometimes prided itself on its purely cultural and unpragmatical outlook. To attempt to commercialize education is no doubt to degrade the instrument of a larger aim and a wider usefulness, and such need not be attempted. Indeed, it is one of the gross faults in the present system that it forces the man of genius and artistic ability to bring his wares to market like a pound of butter. What is urged here is that if a man is to devote two-thirds of his life to a particular task he be granted the opportunity of equipping himself for it by a suitable educational training. No educational system that does not offer him this opportunity is fulfilling completely its social function. But the first necessity is the clear formulation of the science of Industrial Administration and for this there is no lack of materials. Time was when industrial experiments were guarded with the same secrecy as technical patents, but the present tendency is rather to use them for advertisements, though without doubt many have been initiated out of pure missionary zeal. In any case there can be no doubt that it is to the great advantage of industry that these should not be lost sight of in the way that Dr. Taylor lamented. Rather should these industrial innovations be recorded, examined, described and analysed, and the principles that experience has approved be utilized for future guidance. There can be no ordered progress without this.

Technical colleges are of comparatively recent

development and the principle has been conceded in this direction. If technical experts benefit greatly by college training why should not management experts? Why theoretical training in the one case and mere rule-of-thumb in the other? It may be that just as we lost to Germany through our initial neglect of technical research we may similarly lose to America through our neglect of research in the many-sided problems of administration. What is needed is not so much the production of "general practitioners" in industry as the definite training of specialists each capable of assuming in a fully enlightened way the guidance of industry in his particular sphere. It may be that this falls more directly within the province of our technical colleges. It seems to be the established custom of our Universities to teach the pure as distinct from the applied sciences. And it is certain that the usual commercial courses now being promoted in many of our Universities aim at imparting the principles of pure industry, rather than applied or administrative. But after all the main fact is that the need is realized, and the establishment of commercial courses by our universities is a welcome sign of the present trend of events. But further specialization is necessary before the movement can attain its maximum influence on industry. When this has taken place the gap between education and industry will have been bridged to the mutual benefit of both.

To-day British industry stands at the parting of the ways. Our commercial supremacy is being seriously challenged. There can be no doubt as to the advantages our rivals enjoy in natural resources, in conserved strength and in financial position and it is

only by keen progressive methods that we can maintain our ground. After four and a half years spent in producing instruments of destruction there lies at the door of British industry the supreme necessity of increasing production and this can be attained only by a study of the best means of organiisng the factors of production. It is certain that both in America and in Japan the keenest scientific interest is being taken in the problems of business administration. The literature issued on the subject bears this out. Within the last twelve years several hundreds of books have been published in America on the subject of industrial management. Eminent business men, efficiency engineers and University professors have contributed to this mass of literature and the United States Bureau of Labour through its investigators has done much to stimulate the study. Besides these over twenty periodicals appear regularly in the United States dealing with this subject. This progress is being more than maintained in the United States and compared with this the movement in Britain is still in its infancy.

Thus we see that the urgent demands of the present on the one hand and the hard facts of the coming competition on the other alike call for a scientific study of every possible means of increasing output. This can be attained only by concentrating attention on methods of production and administration and the development hand in hand of thoroughly modern technique along with the most efficient management.

LECTURE III.

Some Tendencies in Industry

By E. M. Wrong, M.A.

I.—The Shop Stewards' Movement.

In the majority of trades shop stewards are not the recent creation that we are inclined to think them. Some trade unions are still without them, others have not had them until recently, but in most the necessity of a local delegate, to collect weekly subscriptions, to pass on information to the district executive about the works where he is employed, to act as a link between the union branch and its members in the factory, to be a spokesman who shall represent the unionists in the shop to the foreman or manager, had long before 1914 led to the creation of such officials. Probably the oldest form of shop steward is found in the printing industry, where the " Head of the Chapel," despite his ecclesiastical name, fills the office. To complete the organisation of trade unionism from the national executive down through the district and branch to the individual member, some local delegate, generally called a shop steward, has been evolved.

But if shop stewards are no new thing, the shop stewards' movement is, if anything five years old can

be called new in these times. The old functions of shop stewards in the engineering trades were strictly limited. Their duties and remuneration are laid down in the rules of the Amalgamated Society of Engineers as follows :—

> They are to be appointed by the district committees of the union and to be under the direction and control of these committees. They are to examine the contribution cards of the members of the society and of all new workers claiming to be members, and to report, at least quarterly, to the district committee on any matters concerning the engineering trade; so that the committee may be kept posted on the trend of affairs. Shop stewards also are to report at once any breaches in trade union regulations, and if one of them is discharged because in the employers' view he fulfills his union functions too thoroughly he is to receive full wage benefit from the union. For every quarterly report he is paid four shillings.

Thus, in the A.S.E. constitution, it is clear that the office was intended to be mainly honorary, providing no career in itself though occasionally it has paved the way to full time union employment. The shop steward's duties are not supposed to be onerous enough to interfere with his work and he is designed to be a channel of information rather than a representative of his organisation.

But even before the public heard of the shop stewards' movement changes were taking place. In a few districts, amongst them Woolwich Arsenal, the shop stewards before the war had acquired much larger

powers than the rules of the unions recognised. In the Arsenal they had formed a committee which was recognised by the union and by the government and which was in practice though not in theory a separate district committee of the Amalgamated Society of Engineers.

Still in most cases, the shop stewards were a very minor cog, though a useful one, in the union machine; war conditions changed their position. Strikes were forbidden, strike pay was abolished, the national and district executives of trade unions were more restricted than they had been, and the field was thrown open for new and extra-constitutional leadership. "Rank and file" action as a revolt against official leaders was not unknown before 1914; under war conditions any such revolt looked to the shop stewards for guidance. Changing workshop conditions threw the shop stewards into prominence still more than did the prohibition on strikes. New machines were introduced everywhere, old operations were subdivided, piece-work was increased, dilution was encouraged, and the unions needed far more than before some local leaders to represent their point of view and to keep a record of war changes. In engineering there is no "book" of prices (probably there never can be one); the piece price is fixed separately in each shop, often for each operation or series of operations, and may vary with each type of machine. The shop stewards knew the conditions in the shop better than any district secretary could know them and became the workers' mouthpiece to the management. It was thus in engineering, one of the most conservative of trades, that the movement became most pronounced, for it

was in engineering that conditions changed most rapidly and that feeling grew most acute.

The movement first received public attention on the Clyde but it was springing up at the same time in all the chief engineering centres. In Glasgow it developed its most unconstitutional side,—unconstitutional from the union point of view as well as from that of employers. The prohibition of strikes did not remove grievances but it destroyed the union executives' power of negotiation. The stewards took things into their own hands and formed a "Workers' Committee" consisting of shop stewards from all the works in the district. The district committees of the engineering unions appointed more shop stewards than had existed before; at the same time the workers in some shops elected their own spokesmen without union sanction or ratification. Thus there were two types of stewards,—the old official one, nominally responsible to the union district committee but becoming more and more independent, and the newer type, outside the regular machinery. The stewards in different unions employed in the same works met together; in some cases the less skilled workers joined the craftsmen's organisation, in others the old division between skilled and unskilled remained. To conduct the Clyde strike of 1915, the stewards of different works formed the Clyde Workers' Committee to represent all works in the district. This committee was more industrial in character than any one of the unions which composed it; most of these were craft or "kindred craft" organisations It threatened to usurp the functions previously exercised by the Glasgow District Committee of the A.S.E. and by the Clyde District Committee

of the Federation of Engineering and Shipbuilding Trades.

On the Clyde the movement was thus something of a double revolt, against the employers on the one side and the union executives on the other. Elsewhere the movement has been more constitutional. District committees have grown up in many places, in a few cases representing unskilled as well as skilled workers, while in others there may be separate committees, one for the skilled trades, another for the general workers. In Coventry, where the movement became perhaps more complete and constructive than elsewhere, the engineering unions federated locally into a joint committee; this issued cards to all shop stewards; each shop had its shop steward and the chief stewards in each shop of a works formed the works committee. Unskilled labour and women's unions were represented on the joint district committee,—a step ahead of the common practice.

The Armistice threw the shop stewards' movement into disorder, for the majority of stewards are drawn from the younger and more radical elements of labour, many of whom were dismissed as soon as war orders slackened. For the time being the movement towards workers' district committees has gone to pieces; it may or may not revive, but the works organisation of shop stewards has held together through the break-up of the district committee and it is unlikely that the shop stewards will revert to their previous position as mere agents of the union's district executive.

Outside the engineering industry the movement is spreading gradually,—in the cotton trades it has made a beginning, sometimes unofficially, sometimes with

authority, and the stewards try to deal particularly with such questions as bad material and defective machinery. The chief obstacle that the movement has to contend with is the same as that which confronts labour everywhere in Great Britain, the excessive number of unions and the existence of inter-union jealousy. If the shop stewards are to become a permanent feature of Trade Unionism they must become the official local representatives of their unions or federations of unions. In many cases they are still outside the union constitution; if they are not brought inside they will not be able to strengthen what is undoubtedly the weakest link in the union chain, the relation of the local branch to the individual works.

The movement has so far been rather belligerent in character, a double revolt against the employer and union conservatism, and naturally it has attracted the most extreme elements of labour. Only recently has it become constructive. Taken together with advisory (or executive) joint councils of labour and capital (Whitley Councils and joint Works Committees), the shop stewards are seen to be the extreme left wing of the parties now demanding the parliamentarising of industry and the substitution for autocracy of government by consent. The movement is essentially English in character. When in doubt Englishmen form a committee, whether they are in parliament or in a factory. At present the leaders among the shop stewards are at most lukewarm to Whitleyism, but the breach between the two systems, of purely workers' committees and of committees representing both employers and employed, may not prove insuperable. There is nothing essentially "Bolshevik" about

the shop stewards' movement by itself; it began before we possessed that handy name for anything we dislike, and it is now becoming more constructive and possibly more conservative. Many of the leaders among the shop stewards wish for a complete change in the basis of society, but so do many professors, journalists, clergymen and employers. The movement has been influenced by a political philosophy more extreme than that generally held in this country, but in itself it is not inseparable from the social aim of its leaders, whether these are right or wrong. In any case the chief struggle in trade unionism, that between craft and industrial organisation, is partially met by the development of shop stewards' committees, for if these are wide enough to embrace both skilled and unskilled workers they can become in effect federations in one works or in one district of the labour engaged in an industry. Some trades (notably railways and mines) may not need such a local organisation but others, and engineering in particular, need it badly.

II.—The Profession of Management.

Prophecy is notoriously a risky business. It has been well said that when a man begins a speech with the words "history teaches us" we know that he is going to tell us a thumping lie. In the same way when a man begins "it is inevitable that" he is inviting disaster. Events seem to take a special pleasure in cheating the prophet whether he be politician, journalist or professor; this is natural, because after all change depends more on the human mind than on material forces, and though we have acquired some knowledge

of what material forces are at work and in what direction they are moving, we are still unable to forecast what the human mind will think to-morrow, next month, or the year after this.

Yet one must try to read the future, not because one will read it right, but because the mere attempt to understand in what direction we are going helps us to see where we are at present. Any attempt at prophecy has however to be based entirely on elements in the present situation; we cannot allow for totally new gusts of opinion whose coming and going are beyond our knowledge. We can use the past and some of the present in trying to build up what the future will be, but there may be new factors in the future as yet unguessed. No one, for instance, could have foretold Christianity before Christ; in the first century the papacy could not have been predicted; in the middle ages it would have been impossible to foresee that the north of England would become more populous than the south.

To come down to industry, there is one thing we can be sure of, that whether conducted by private enterprise, by the state, or by national guilds, it needs and will need management. It must have a policy and that policy has to be applied in countless details, modified to suit new conditions. Whoever will appoint the managers of the future—shareholders, parliament, or the workers—managers there will have to be.

At the present time management can roughly be divided into two categories. First there are the big companies—the railways, the huge engineering associations, the banks, to mention only a few. In these control is actually exercised by salaried managers,

that is to say the daily incidents of business have to be dealt with by employees of the firm, as there is not time for these to consult the shareholders, often not even to ask the directors' permission before deciding on action. In these firms management is as a whole, in different hands from capital; the manager and the capitalist are two, not one. Secondly there are the businesses, generally smaller than the first class, though often very large, controlled by a family interest, or by a group of families, frequently companies in name, sometimes with their shares listed on the stock exchange even if unobtainable in reality, but always with more of personality about them than is possible to a huge stock corporation. In these management and proprietorship are closely related.

The family business is probably waning, the joint-stock company is on the increase. There are about 58,000 joint stock companies in the country, with a nominal capital of some £2,300,000,000. Since 1884 the number of joint stock companies has increased enormously. To take the case of cotton textiles only; in 1884 over 77% of the spinning firms in the country were private affairs, not companies; by 1914 the percentage had fallen to 16. In 1884 91% of the weaving firms were private, in 1914 only 48%. Probably the private firm will continue to exist as a transition stage for growing businesses, if as nothing else, as long as private capital remains, but it has lost the pre-eminence it enjoyed when Adam Smith wrote the "Wealth of Nations."* Meanwhile it is better to treat "management" as something separate from ownership, for that

* See *The Industrial Outlook*, p. 49 (Ed. Furness).

is its general position. Managers may be shareholders, but they are not the only ones, and management is steadily becoming more and more a thing by itself, apart from capital.

Management exists then as a separate party in industry, distinct from labour or capital, only fully in the bigger businesses. In the smaller private business management is generally in the same hands as ownership and cannot be divorced from capital, but in the big company management has its own problems, its own interests, quite distinct from those which face either capital or labour. Between these two management is often liable to be badly squeezed; it is seldom recognised apart from capital, yet capital controls it and not it capital, so that it is often denounced for what is not its fault. Sometimes management, capital and labour, not to mention the public, are all dissatisfied with the results of industry, and if we try to account for this we may be driven back to the conclusion that the crying defect in present day organisation is the almost complete absence of any direct line of responsibility such as we have developed in politics, but which industry is still without.

How does the chain of responsibility run to-day in one of the big industrial or transport enterprises in the country? The shareholder is nominally responsible for what is done in his name. But the individual shareholder, unless he be a capitalist of importance, has no real control, no real responsibility; as Prof. Graham Wallas points out he can influence the policy of the big enterprise more effectively by staying at home and writing letters to the press—that is by doing what any member of the public can do—than by

attending the annual meeting and speaking and voting against the directors.* The shareholder can hardly be held responsible for the exercise of power which in effect he has not got. Then are the directors really responsible officers? They are elected by the shareholders and responsible to them, but in at least nine cases out of ten the directors' recommendations are accepted without question by their electorate. Yet the directors are not held fully responsible, nor called to rigid account when the business is inhumanly conducted. They govern for the most part through appointed managers and avowedly in the interests of their shareholders. Their policy may be disliked by the majority of shareholders, but if they are above suspicion of dishonesty they are almost certain to be re-elected year after year.

It is here that the chain of responsibility often breaks down. The directors leave details to salaried managers but reserve the right of veto, and do not by any means always follow the advice of their experts. If asked to make changes that will cost heavily they are rather inclined to hide behind their shareholders, who know nothing of the particulars of the business, and to shelter themselves behind widows and orphans, dependent, or so it is alleged, entirely upon dividends produced by the industry. How far these widows and orphans really exist one cannot say; they may be as mythical as the orphans in the "Pirates of Penzance," or they may hold most of the shares of every business in the country. One director has stated that it would be a good thing if every firm had to announce publicly

* See *The Great Society*, p. 3[illegible].

which of its shareholders were actually widows or orphans. But in any case it is certain that the chain of responsibility does not run through managers, directors and shareholders as directly and efficiently as, for instance, it runs in politics, through the cabinet, parliament and the electorate.

Of course a great many of the big industries of the country are now publicly owned and controlled: electricity works, tramways, water and sanitation, some shipyards, arsenals, and so on. In these one might expect better conditions, not necessarily of wages and hours, but of responsibility. But the company methods have spread beyond the company and what frequently happens in a municipal enterprise is that all power is concentrated in the hands of the permanent officials together with those of one or two members of the governing committee. A municipal servant at the head of a department is like a manager appointed by a board of directors except that he generally has more power and his recommendations are followed after little or no discussion.

One expects the private business to be more human, more adaptable, more elastic than the public company. But the private business has to compete not only with oversea competitors but also with companies in this country; it is often insufficiently capitalised and cannot venture to make experiments that may prove costly and not bring an immediate return. Also, the managerial-proprietors of private companies are very often less well educated, less capable technicians, less diplomatic persons, than the salaried managers of big companies. They tend to be autocratic with the autocracy so common amongst the half educated,

and even if their methods are more personal than those followed in the big company they may be quite as soulless.

We can be sure of one thing. Unless human nature changes considerably, unless mankind decides against democracy and comes to believe that the duty of most persons in the state is unquestioning obedience, industry will have to discover some more satisfactory method of responsible government than now prevails. As a change in our views on democracy is unlikely, management will need to constitutionalise itself in some way; it cannot remain indefinitely in its present unsatisfactory position.

There are some features in the present position which it may be possible to chart, and which may give us some clue as to the probable trend of events. The first of these is this: industry is every year becoming more and more strongly organised on both sides. Trade unions and employers' federations are both more prevalent and stronger than they were a few years ago, and the movement towards effective organisation has certainly not yet reached its high water mark. There is increasingly little room nowadays for individual agreements between the employer and his own employees on such questions as wages, hours, conditions of work. These things have to be settled by the organisations of labour and capital, with or without the assistance of the government; they are not now left to the individual employer.

Secondly, in most industries, though not yet in all, this country is now alive to the necessity of recognising organised labour. The nineteenth century habit of the employer saying "I will deal only with my own work-

people " has been generally discarded, though it lingers still in a few badly organised trades. In this respect Great Britain is a good distance ahead of the United States, where many employers still assert, in all seriousness, that they must save their own workers from the " tyranny " of the trade union. Here at least we recognise the right of organisation, and we are beginning to go a step further, to favour organisation and to make use of it in the interests of trade. Many employers prefer to deal with a strong union rather than with non-unionists or half a dozen weak unions. They know where they are when the union is strong; they can rely on agreements being ratified; they can even in hard times reduce wages more easily than when the unions are too weak to sanction such a reduction without loss of membership.

Thirdly, the state cannot be neglected. A great deal of nonsense is preached about the inevitably evil consequences of state interference, but we could not have got through the last five years without government control, and those who want us to wipe out all the activities taken on by the state since August 1914, are asking history to do what it has never done yet, to turn round and retrace its footsteps. If we analyse the objections to government interference that are most common we find them capable of being reduced for the most part to the following :—Complaints against the Liquor Control Board (this is what many parliamentary candidates at the last election understood by " the restoration of British liberty "), objections to any action that limits the amount of profit made by industry, and fear that state action is bound to be unsympathetic and inefficient. Much state

action is, and has been, inefficient, but not so much of it as is often claimed has been worse than the policy of many industrial enterprises when not interfered with. To insist that the state must always be inefficient is to take a very low view of human nature.

In any case, the influence of the state has grown, and the nation cannot give up all the functions taken on during the war. The state is at least interested in the rates of wages paid, in the abolition of sweating, in the manufacture of certain articles which have been proved necessary but which when left only to private enterprise, were neglected. Objections to the state interfering in these things are on a par with the objections so strongly put forward by Bright and Cobden to factory legislation; they are out of date and not based on any live social philosophy. The state will probably have to fix the general conditions of industry far more than it did or does, although the complete control over supply and output that was exercised during the War will not be so easy now and may not prove desirable. During the War there was a practically unlimited demand for nearly everything; the chief need was intense production. Now we need co-ordination and the application of united intelligence to our problems. We have at last a Ministry of Labour; we may soon have a Ministry of Supply, and things cannot be as they were before.

If the trade unions grow in strength and the state fixes the general conditions of labour it is probable that we shall eliminate the unfit producers more rapidly than we did. It is to be hoped that we shall; the chief justification of private enterprise is efficiency, yet before the war a large number of firms dragged along

living on a past reputation, and never really grappling with their difficulties. Limitations destroy the unintelligent while they give the artist his opportunity, or as Mr. Chesterton puts it " the most beautiful part of the picture is its frame."

Management will probably be exercised in a more limited sphere and at the same time more intensively within that sphere; it will cease to be an autocracy and will become a limited monarchy, and possibly in the end a republic. It should be the more efficient for the change. The manager will not have to consider many things that now absorb much of his time and effort; he can concentrate more on specific questions, and become less of a rule-of-thumb man than he has been. Government in industry is becoming more and more constitutional; to-day it is rather like the government of England after 1688 and it may become like government after 1832. It should be possible for management, working in a sphere more strictly defined, to build up a technique that now does not exist, for science should, if the best is to be got out of it, be applied within strict limits and without too many variables.

If this comes about, management will become more and more of a learned profession, as predicted by Mr. Sidney Webb.* It will perhaps approximate more and more to the other learned professions—the church, the bar, teaching. Possibly managers will form an association without whose licence no one can conduct a business, just as doctors and lawyers restrict admission to their professions. People may in the future be

* See *The Works Manager To-day*.

"called to the office" as they now are to the bar. Probably there will be a greater differentiation than is now made between technical knowledge and management; such a distinction is quite possible, for technical knowledge is primarily concerned with material difficulties, management with men and women. Admirable technical knowledge, great inventive ability, do not always carry with them the power of managing human beings, and this is now recognised in many ways, especially perhaps in the family businesses that are still so numerous in the north of England. In these the son is taught to assume control of the business while still fairly young; he is not trained himself to solve the technical problems that may arise, but to call in specially skilled persons for this, while he himself concentrates on matters of policy.

More and more the manager, as opposed to the scientific expert, will be concerned in dealing with men and not with material. Committees will take much of his time—Works Committees, Whitley Councils, formal meetings with representatives of the State and of Trade Unions, informal conferences with other managers, with Union officials, with his own workers, consultations between department managers, works managers, foremen, inter-departmental discussions. There will have to be more devolution than is now generally the case, or else he will not find time for these exacting duties. At present industry suffers from the fact that not enough people exercise any sort of responsibility, or want to exercise it. Problems, in nearly every part of a works, are dealt with by single-handed effort. In the shop everything comes on the foreman, who has been well defined as a man in

a bad temper and a hurry.* In a department everything comes on the departmental manager; in a works on the works manager. The definition applied to the foreman can often be used all the way up the tree.

The question of what is called "scientific management" is a big one and can hardly be dealt with here. Scientific management has a bad name with organised labour in this country, as indeed in the United States, and it has not yet established itself as a standardised method of administration, nor has it proved itself invariably scientific. But this is certain, that a greater application of science to industry will come, not only in the use of technical processes of an improved kind, not only in more economical labour-saving devices, but also in the relations of worker to management, in the growth of constitutional methods of government, in the application of personality and method so as to achieve a systematic whole. In so far as "scientific management" is really scientific it will prevail; but a great deal of charlatanism has masqueraded as science in the past and is not yet eliminated. There will be no room for a "scientific management" that is merely man-driving under another name, nor for science that contains a large element of quackery and sets up claims which it cannot maintain when impartially examined. But there is room for real science both in organisation and in technical processes.

What is probably one of the most fruitful sides of "scientific management" is the emphasis laid by it on functional devolution, and sooner or later

* Mr. H. N. Casson's phrase.

management in this country will have to decide not only in favour of increased devolution but also in what way that devolution shall be made. Shall management be functional or departmental? Shall it, as political government is now, be departmental or geographical, or shall it, as political government seems tending, and as guild socialism demands, as the Whitley Councils promise, be concerned rather with the functions fulfilled by different men than with the departments in which they work, or the places where they live?

Most large industries have grown from small beginnings, and their growth has been somewhat like that of the amoeba,—at a certain stage they divide, or throw off another department. The small shop becomes a big one; a new line of business seems promising and a sub-department is opened to deal with it; the sub-department proves a success and the process is repeated. Or else new departments come through an increase in the amount of work going through the shop which makes it possible to divide it into parts with some degree of accuracy. With the rise of departments comes a feeling of departmentalism; water-tight divisions are apt to grow until the works manager has no access to the accounting department, the sales manager no access to the shops; in some factories departmentalism goes so far that each department does its own buying, instead of having this united under a buying manager with specialists from each department to advise him. A works can suffer from just the same sort of departmental jealousy that rumour attributes to Whitehall, and this cramps the efficiency of the whole, yet is not easily avoided. Institutions do not grow up in a vacuum, irrespective of the characters

of the men who work them, and an industry's departments have all some reason behind them, even if the real cause for their existence has disappeared. You cannot scrap departmental organisation without the consent of the departmental managers if you are to retain the services of those managers. So the process of transition to functional management is slow; nor is it always complete; none the less a gradual change in that direction is taking place.

The relations of labour to management are at the present time unfixed; labour has established a veto in certain fields, it has a varying amount of influence in others, but as yet it is fundamentally irresponsible as regards the whole of industry. It has no share in the government, and it is not even recognised like a parliamentary opposition; it is not, and at present cannot be, asked to take office. It cannot be sure that its questions will be answered or that it can secure information on any specific point; there is no question time in industry. Can one expect nothing but responsible behaviour from a body not offered responsibility? Yet it is not easy to extend responsible government in a works. It is often suggested that foremen and charge hands might be elected, yet most of those in close touch with actual conditions say at once that election will probably not secure the best foremen, and that the change would be exceedingly risky. It might be easier to initiate labour at both ends at the same time, in the works by means of a works committee, and in big national industries such as railways, by electing some, if not at once the majority, of directors by popular vote of the workers. A director chosen by a large constituency would be more independent

than one responsible to a works meeting, convened when any grievance, fancied or real, has roused opposition and shaken his popularity. Perhaps the Montague-Chelmsford report on Indian reforms will point the way; industry might try a "dyarchy," handing over discipline to a Workers' Committee, while leaving policy, finance and sales under the control of the directors.

At the present time, when parliamentary institutions are rather out of favour, it may seem unwise to argue that industry needs to be parliamentarised, and yet this is the case. Whatever faults we may descry in parliamentary government that system of conducting the state has not been a complete failure; it has succeeded in providing something like a continuous chain of responsibility between government and governed; it has allowed the people of the country to get roughly what they wanted done, and it has proved itself fairly adaptable to new conditions. It would not be possible to transfer political institutions wholesale to industry, but the spirit of those institutions might be applied, and new constitutional forms adopted through which industry can be conducted more in accordance with the general will than is now the case. This ought to be possible whether industry is nationalised or not; at the present time it seems unlikely that anything more than natural monopolies and not all of them will be put under the direct control of the state. But private industry as well as public will have to work within more definite limits than it has in the past, and will have to develop a responsibility of its own.

It must not be forgotten that, though war conditions

no longer apply, the experience gained during the War by many who used to have little chance of joining in the actual business of government, remains and will prove a valuable asset. The labour leaders have now obtained a far greater experience than they had before. Those who are not leaders, some of those who never will be, have begun to see the need of government and to understand some of its difficulties. The situation is perhaps like that in political affairs in the 17th century. Then it was thought by most students of politics that parliamentary government wonld prove impossible, mainly because the personnel of the House of Commons fluctuated from election to election and hardly any of its members had any true acquaintance with the real necessities of the situation. But those who thought this were wrong, and those who think big innovations in industrial government incompatible with efficiency may be equally wrong.

Apart from the big constitutional changes there are some minor things to which management will have to pay attention. Management, being for the most part over-busied about many things, does not study labour enough. Its higher grades are often far too ignorant of the formal aims of trade unions, and still inclined to attribute labour troubles to " agitators " on the assumption that by labelling a man as " agitator " he has been disposed of. This attitude is fortunately disappearing. Secondly, except in a comparatively small proportion of firms, management does not make sufficient use of scientific investigation. Fatigue and accidents, in their relation to output and time-keeping, are generally neglected save when the government or the unions force consideration. Thirdly, management is

often appallingly stupid even in dealing with its own interests. There are frequent cases when the clerical staff, for instance, are not allowed to take a holiday when the day and piece workers are off, the argument being that the clerical workers receive regular holidays and an annual salary and they are not entitled to any extra vacation. This is true, but when it results in keeping an office full of people, not half of whom have anything to do, it is easily seen to be short-sighted. Or take the case of clocking on and off, an almost universal practice. Clocking on is useful, but clocking off sometimes leads to a queue in front of the clock, and in order to get out at the set moment people leave their work in advance so as to get a good place. The insistence on clocking off may mean an actual loss of working moments that becomes large in the aggregate.

Management, as a class separate from capital and labour, lacks unity and organisation. Its higher grades are more in sympathy with capital than with the unions. Its lower grades find their more natural associations with labour, and yet are divided from it. Were management united, it would have more power than it now possesses. Perhaps there is a natural divergence of interest between the lower and higher grades that will prevent real solidarity, but in the past the separation of the two has proved unfortunate for foremen and charge hands. They have had to bear the onus of a policy which they might not approve and certainly did not originate. They have been unorganised, pressed on from either side, and probably capital has weighed the harder. Trade Unionism is now making a bid for their allegiance, and it seems not unlikely that they will swing in that direction.

LECTURE IV.

Taylor's Principles in Modern British Management

By A. ROBERT STELLING.

THE most vital problem which faces the Industrial Manager of to-day is the increase of production—how to increase the output of the factory as a general question, and how to increase individual productivity as a special investigation. The colossal economic waste which obtains in so large a percentage of our factories must be reduced—it can be reduced if a whole-hearted attempt be made to do so, but it must be by means of comprehensive effort and not merely as a result of series of spasmodic disjointed experiments.

Many incomplete solutions have been put forward and all have failed fully to achieve their object, principally because the whole problem has not been visualised as a complex group of human and mechanical elements, all of which require the most careful co-ordination and consideration of their relationship to each other. Thus, we have had proposed as solutions on the one hand the introduction of more machinery

and mechanical substitutes for hand labour, "American Methods" (whatever that may mean), strict standardisation and other ideas, all of which affect the mechanical element.

On the other hand is suggested profit-sharing, joint control of the industry, better housing conditions, welfare work generally; suggestions affecting the human elements only constitute the royal road to increase of output. All these ideas fail to achieve their object, because they are only partial solutions. What is wanted is a basis of solution which will co-ordinate the development of both elements, and such a basis is provided by the whole-hearted acceptance of Taylor's principles. Taylor's methods are well known, and many are not applicable to this country as I shall presently show, but his principles are very little understood and they are as true to-day as forty years ago.

There is a very great danger in the partial acceptance of his principles of Scientific Management, or in attempts at partial solution of the problem. Everyone who has studied the development of industrialism for the past generation must have observed how the increase of output has been forced in the factory by purely mechanical means, and how it has been one long fight, disastrous in the long run though possibly momentarily successful to one party or the other between worker and employer, the employer trying to force up output and the worker trying to force up rates of pay; both sides applying "ca'canny" methods, one in regard to pay and the other in regard to output.

All sorts of mechanical methods to increase production have been tried with partial success and with lasting deterrent effects. Then during the last few years a

wave of re-action has passed over industry and we have seen what some employers do not hesitate to call " Welfare gone mad." We are living in this phase of re-action to-day and I say there is every bit as great a danger to the industry in neglecting the mechanical side at this juncture as there was in ignoring the human side earlier on. Welfare work in its true sense is vital to industry to-day, but we must incorporate it scientifically in our modern methods of management.

Let us consider for a moment why scientific management, or as it is sometimes called, the Taylor System, has met with so much opposition in this country.

I think that the principle reason for this lies in the ill-considered adventuring into its domains by those who have imperfectly understood, or possibly even only studied superficially the basic principles upon which the Taylor System is founded, and this proves the statement which I have just made, that there is a very grave danger in failing to accept and apply all four of Taylor's principles at the same time.

What actually happened has been something like this—the British Manufacturer, observing the results of Scientific Management in America, made a somewhat superficial examination of the methods employed; he then tried such of these methods as appealed to his temperament particularly, or which seemed to him to promise the most immediate results.

The first phase adopted in this manner was the timing of operations by means of a stop watch; but the real reason for such timing was lost sight of. Taylor's principle in setting times as a result of stop watch observation, was to establish a condition of working which would render the maximum output possible

that was compatible with an absence of over-strain on the part of the operator.

The British Manufacturer's idea, unfortunately, was to cut his piece rates, and, it must regretfully be said, to limit the earnings of his workpeople. It is only natural that the stronger organised Unions took objection to this method of reducing their earning power and reducing their power of collective bargaining, with the result that to-day, in the majority of trades, any attempt to introduce stop watch timing methods, *without such compensating features as would be applied if all Taylor's principles were adopted*, would lead to an immediate cessation of work, a strike which would be supported by the other Unions in the factory or the district.

The next attempt at the application of scientific principles was made when the British Manufacturer harassed by continued delays in delivery, and by loss of money and further business consequent thereon, observed that wonderful results in obviating delay were achieved by his American competitors with the aid of Planning Departments; but with his ignorance of what constitutes the true cost of production he could only see in a Planning Department run on American lines an excessive addition to his standing charges account, fallaciously termed "dead charges." He therefore whittled down an efficient Planning Department into a totally inefficient Progress Section. This Progress Section in many cases consisted merely of one clerk ignorant of technical processes whose job it was to extract promises from harassed foremen and to chase up these promises on the day on which they should be fulfilled. But this chasing made from

Department to Department without full consideration of all factors involved in the completion of the contract, only resulted in hostility on the part of the foreman and bad feeling between Departments. At the same time it did little if anything to reduce delays, consequently in this case, particularly from the employer's side, another of the methods of the application of Taylor's principles became discredited, and was discarded as being an impracticable theoretical idea.

The third phase was the attempt at specialization coupled with the introduction of automatic machinery, and the consequent splitting up of operations into components. But sectionalisation existed long before Scientific Management was ever seriously discussed in this country. In the Textile Machinery Trades in Lancashire where the design of certain machines has not varied for a generation at least, men work day in and day out on exactly the same operation, or piece, but whereas under the Taylor System, opportunities are given for a man to progress and improve his position, nothing of the kind exists in these cases. When I was an apprentice I knew one turner who had worked for thirty-five years at one lathe situated under a staircase and illuminated on an average six hours a day throughout the year by a single batswing gas burner. He had only had four different articles to manufacture during the whole of that period. When the work was transferred to another and modernly constructed factory with proper lighting and working conditions, this man found it impossible to adapt himself to his new surroundings, and finally left the services of the firm; and yet this man being a member of the Union was held to be a fully skilled craftsman.

The effect of this specialization in many of our Engineering Shops is very marked, when, as the result of some dispute, a man leaves the service of the firm with whom he has been employed for five years or upwards but finds it almost impossible to work in his new surroundings, and usually makes an effort to get back to his old job.

The objectors to the Taylor system would say that this is exactly what happens under the application of Scientific Management. Exactly how this objection is met with will be explained later in the lecture. These are only a few of the reasons why both employers and workers have come to distrust "Taylorism." The cry "we won't have Taylor" is really based upon ignorance of what Taylor's principles really involve, and the lack of consideration of the methods of their application which should be adopted in this country; hence we have the attitude on the part of labour that it tends to overspeed our workers and to render their work soulless and dull, and on the part of the employers that it is a theoretical fantasy, expensive in its application, negative in its result, and liable to cause friction between foremen and workmen.

Now there can be no doubt whatever that beneficial results are certain to be achieved if Taylor's principles are applied with a proper understanding of the conditions of labour in this country; in fact I go so far as to say that our only hope of obtaining the increased production which is so vitally necessary to the welfare of this country lies in progress along the lines laid down by Taylor and to indicate what modifications to his methods are necessary to obtain successful results is the purpose of my lecture to-day.

Taylor summarised his principles under four headings. These were :—

1. The establishing of an exact science applicable to the industry concerned based upon natural laws as contrasting with the old rule-of-thumb slip-shod methods.
2. The scientific selection, training, and development of the workers.
3. The securing of the hearty co-operation of the worker with the improvement of working conditions of the industry generally.
4. The adequate division of responsibility between worker and management.

In replying to those who consider the Taylor system inhuman it may be pointed out in passing that in Taylor's four principles only one is concerned with the impersonal factor and the other three apply directly to the human nature side of the problem.

Before examining these principles at further length it would be as well to review the conditions with which Taylor was faced when he commenced to improve his methods of management.

In the first place there was an absolute ignorance in the Engineering Trade of the metal removing capacities of steel and machine tools. No one had ever seriously investigated the economical side of belt driving. The development of high speed steel is entirely due to the experiments which Taylor carried out in an endeavour to establish an exact science as applied to his own industry.

He had a large casual labour market from which to select and draw the men suitable for his experiments.

He had a few skilled tradesmen at his disposal; on the other hand, all the off-scourings of Europe were ready to take up any job at any price. With such material at his disposal and with fourteen different languages spoken in one shop is it any wonder that it was practically a necessity for him to deal with his workpeople as automata? Another thing, although Taylor complained of shop tradition, this was not so deep rooted as it is in this country, due to the more recent industrial growth.

Contrast these conditions with those facing the industrial manager to-day. Thanks to Taylor in the first instance and to the research work which has been carried out so successfully at our Technical Colleges and Universities, our knowledge of the materials of all industries is very perfect and widely disseminated. The study of the job, as I shall presently show, runs along local lines rather than upon general ones.

The labour problem is a totally different one. The Industrial Manager to-day has to deal with craftsmen who possess generations of inherited trade skill. They are well organised in craft Unions and, as a result of the unfortunate adventures which I have just described, they are bitterly opposed to a something which they hear described as "Scientific Management," and which they vaguely understand to be inimical to their interest. Added to this we have deeply rooted shop and craft tradition and custom, which is difficult to overcome and which forms a serious hindrance to progress. As often as not, there is no logical justification for such custom—it just happens to exist and therefore must be observed. *We see, therefore, that the solution of the whole problem of the application*

of Taylor's principles hinges entirely upon the psychology of the British workman.

The first principle—the establishing of an exact science. When the production or the manufacture of an article of commerce is studied it will readily be seen that all processes will fall into one of two categories, which I shall describe as the Mechanical Effort or the Impersonal Factor, and the Physical Effort or the Personal Factor.

The study of the Impersonal Factor necessitates still a number of experiments which must be carried out in the workshop itself. For instance, the quality of the raw material which is usually worked up may be found to be of such a character that the advertised speed of the machine supplied by a specialist manufacturer may be found to be uneconomical to meet the case. It should be noted that the most economical speed is not the fastest; the wear and tear of the machine has to be considered and the quality of the intermediate product for further processes is also to be taken into consideration. Therefore it becomes necessary to establish a standard of the most economical speed at which the machinery itself should run and this economical speed may vary with each consignment of raw material.

The Industrial Manager must therefore exercise his judgment as to whether the variations which occur in the quality of the raw material are sufficient to justify the establishing of a special Testing Department and the changing of the speed of the machinery to meet each case; but in any case he must establish a mean standard of manufacturing speed. Any other speed than the one determined to be the most economical

represents economic waste—a waste which cannot be tolerated in these times,—and assuming that the Manager provides the correct appliances wherewith to produce quality of workmanship, there should be surely no cavil on the part of any representative of organised labour against the establishing of this economical speed of the machine, a factor which stands in no relationship whatever to the Physical Effort of the worker.

The study of the Personal Factor, that is to say of the Physical Effort which must be put forth by the worker is more involved. It necessitates in the first place a real knowledge of what constitutes over-strain, which is an unhealthy state, as distinct from fatigue which is a normal healthy condition resultant upon any effort.

It also necessitates the most careful observation of the movements of any worker and the elimination of such movements as are wasteful of energy and productive of over-strain.

But how is this motion study to be applied in this country? It is not possible to stand without further ado by the side of a machine, stop watch in hand, nor is it compatible with honesty in industry to make observations secretly. But the fact remains that motion study must be applied to secure maximum production and freedom from over-strain, and it can only be applied with the consent of the workmen concerned.

The obtaining of this consent is easily achieved, as I have definitely proved to my own satisfaction, if you can prove to your workers that the application of the other principles of Taylor's Scientific Manage-

ment has resulted in benefits to all parties concerned. In particular it is possible to prove to the worker that by considering such questions as ventilation, lighting, and standardised conditions for his machinery and equipment, his work is rendered more pleasant and less tiring than it was previously. The obtaining of the "hearty co-operation of the worker" which forms the third principle is therefore obviously bound up with the application of the first principle.

Apart then from the cruder forms of motion study such as altering the general height of benches, work tables, etc.; the providing of lifting appliances and runways, or conveyors, it is obvious that motion study is the very last of all the phases of Scientific Management which must be attacked. It is useless in this country to attempt, as some individuals are doing, to apply motion study without the whole hearted acceptance of Taylor's other three principles.

The second principle—the scientific selection, training, and development of the worker. In the course of the study of the job it will be found advisable and desirable to split up into a number of operations the performance of some work hitherto carried out by one man. This will permit the introduction of special appliances and machinery, thus rendering the production of the work more economical.

It follows that by dividing the work up into a greater number of occupations, totally different types of men are required to perform the specialised efforts, and the selection of the men for the actual work presents quite a difficult problem.

With Taylor no difficulty was encountered in making his selection from an unorganised labour-market, but

to consider the selection along these lines among the craft Unions in this country where normal unemployment does not exceed 3 to 5% is unthinkable.

It should be pointed out that in our present old fashioned methods of management a certain amount of natural selection obtains, that is to say, men gravitate into certain classes of work and never vary from these during the whole of their employment. The foreman has certain jobs in his mind which he naturally always gives to one man and this man is perfectly content whatever Labour Leaders may say, to work at this one job because he knows he can comfortably earn a good bonus.

If has been my experience that by far the majority of workers prefer to stick to one job rather than be constantly changing from one class of work to another. One reason which has been given to me for this has been the freedom from worry which the starting of a new job entails; but it may be mentioned in passing that the worry is typical of the old fashioned methods of management where the management neither shoulder their responsibility nor even realise their duty; under which it is always " up to the workman " to muddle through the job, and where the workman always gets the blame if something goes wrong.

We must face the fact that the organised craft Unions hold that all their members must be considered as fully qualified craftsmen, and that the selection of men who are psychologically and physiologically suited to work alongside members of this Craft Union would not be tolerated for a moment although many of their members are in their turn psychologically and physiologically unsuited to the work.

We can only make vocational selection in this country

in our own works, among the lesser organised trades, and the members of such Unions are sympathetic to such selection for they realise that it is only along such lines that they can hope to assure their members improved remuneration and security or continuity of employment.

Where we must apply vocational selection is in the training during adolescence, in order to obviate the appalling waste which occurs every year by the swelling of the ranks of casual labourers through their inability to earn a livelihood in an occupation into which they have been pitchforked by chance. During the latter days of school life psychological tests should be applied in order to advise boys and girls as to the type of career which they should follow with the most reasonable hope of success.

We must also pay far more attention to our apprenticeship system. According to so-called "Scientific Management" the apprentice system is entirely done away with. Now a true apprenticeship system is absolutely necessary and cannot be dispensed with, in many of our highly skilled trades, such as, for instance, Pattern Making, Tool Making, Instrument Making, and in these trades the training of the apprentice should be most carefully thought out and applied after it has once been agreed that he is following the trade most suited to his ability. But there are many other trades in which an apprentice system, as it is understood to-day, is totally unnecessary and in many cases unjustifiable. In these trades as well as in those trades where obviously no apprenticeship system can be applied, very drastic steps must be taken to prevent a form of waste which is a national loss.

I refer to the criminal loss of time and waste of brains and muscle which occur when boys are put to work on jobs which lead only to the dead end of a blind alley.

It is computed, for instance, that in the cotton industry alone 50% of the boys employed therein do not remain in the industry after the age of 18. This is a waste of potential ability which forms a national loss. It is here that were it given a free hand modern management by the application of the second of Taylor's principles could be of the utmost assistance. There is no reason why in any trade the work could not be so studied and so graded that all those entering into the industry would find continuous employment therein, gradually working their way from one job to another requiring a greater amount of skill bringing with it natural increase of remuneration so that a progressive scheme of employment could be developed. Naturally in this process of grading, vocational selection, training, and development would find their complete justification and success.

To my mind this is one of the most important phases of industrial life in which scientific management can assist, and this ideal forms a complete refutation of the objection that "Scientific Management" renders the worker a mere cog in the machine without chance of betterment of his position or of obtaining a training which would fit him for other work.

The third principle—the securing of the hearty co-operation of the worker.

The dominating factors in the lives of the workers in this country taken as individuals, are the desires for security from unemployment in the first place and adequate minimum wages in the second place. Such

aspirations as the control of an industry, etc., are to my mind of secondary importance as applied to the majority of the workers and it is principally among the better educated workers, and among those intellectuals who have thrown in their lot with the Trade Unions, that aspirations along these lines are fostered.

In his lecture Mr. Rowntree held that it is necessary to grant a control in the industry to the worker in order to obtain industrial peace, in other words to obtain the " hearty co-operation of the worker." But as, he admits, no one has yet successfully defined what " adequate share of control " really means, in considering this question of obtaining the co-operation of the worker as far as the application of Scientific Management is concerned, I do not propose to deal in any great detail with this aspect of the problem.

Turning now to the question of security of employment, there is no doubt that the present insecurity is one of the main-springs of industrial unrest and every effort must be made to render employment as steady as possible, and where unemployment of necessity must arise, to render its results less oppressive to its victims.

Continuity of employment depends upon continuity of trade and continuity of trade is inseverably bound up with our export business. Is it not possible for the administrators of our industry, for the Higher Management as it is called, to organise intelligence services reaching into all markets of the world, laying their plans of campaign in such a manner that more constant demands are made upon industries than is the case at

the present? It is a matter for organisation among employers, for agreement to modify old fashioned standards, for mutual financial arrangements in order to finance the export business, and on these lines it is vitally necessary that immediate action should be taken quite independently of any Government Bureaucratic Service.

It has been alleged that Scientific Management is faulty in that it does not concern itself with distribution, but surely Scientific Distribution is bound to be developed coincidently with scientific development, otherwise there could be no outlet for the scientifically produced articles of modern factories.

That the two are further bound together must be agreed if we are to accept this third of Taylor's principles of Modern Management because it is obvious that we must overcome the fear of over production which, existing as it undoubtedly does in the minds of so many of our workers, prevents us from obtaining their hearty co-operation in the improvement of our process.

It is a national essential at this juncture in dealing with the question of adequate minimum wage and adequate reward, that the question of payment by results must be carefully studied, for very serious opposition is at present encountered to any system of reward for increase of output. The opposition to payment by results is founded on important factors.

First, that practically every system which has been introduced into this country has been used by employers to limit the earnings of their employees.

Secondly, that by attempting to speed up without providing standardised conditions to eliminate any

extra effort on the part of the individual, over-strain must follow.

Thirdly, that never having been properly explained and having been imposed in an arbitrary manner without the consent of the workers, grave distrust has been engendered.

Fourthly, it is alleged that it prevents collective bargaining.

These factors are usually summed up by the average artisan in one sentence—" Payment by results is used to cut rates." Agreed that it has been so used, no right thinking employer would so use it to-day and the acceptance of Taylor's principles makes such an objection quite untenable. The setting of task times has been done arbitrarily in the past as a result of a fight on both sides—Taylor's first and third principles entirely violated. I will not labour this point but will ask you to consider another aspect, what does rate cutting mean?

If we are to accept the " Standard Rate" proposal put forward by Mr. Sidney Webb, then a fixed sum should be paid for the production of a certain article irrespective of the method of production. This is merely asking for stagnation or for further quarrels between employer and worker. I hold that there are two standard rates which have nothing in common—the basic economic minimum wage and the economic speed of production. Both are subject to variation, the economic minimum in respect of the cost of living; the economic production rate as science and brains combine to improve processes of manufacture. Over and above the economic minimum the worker should be paid a reward in proportion to his

achievement of the economic task time (not the fastest, bear in mind, but the most efficient); that is to say (if we carry the argument to its fullest conclusion) in proportion to his service to the community by eliminating waste. This is the true aspect of payment by results; collective bargaining must, and will continue, unhampered by any science of management, concerning the basic minimum. This being guaranteed, the reward for efficiency and service should follow strictly the laws of economic production. Here again we observe the linking of the first principle—the scientific study of the work to be done with this the third principle now under review.

In ascertaining the economical production time we must be perfectly honest with the worker,—he must have the fullest access to records and calculations if necessary, and above all the management must issue with every piece of work which has been investigated and given out a clear sheet of instructions showing *inter alia* how the task time is made up.

Another phase of obtaining the hearty co-operation of the worker is the encouragement of his initiative by adequate reward and fair dealing. There is an unexplored mine of untold national wealth in the inherited craft skill of our artisans, an asset which threatens to become a wasting one due to the stifling effect of the struggle between unscientific employers and workers whose experience of the respective tactics of former managers renders them hesitant to develop their skill for the profit of others. The application of our principles far from stifling craft skill, as has been alleged, encourages it by establishing reasonable reward, and further by collecting the experience

of the best craftsmen preserves it for the future and transmits it to others according to our second principle. Such a system of rewards for suggestions must comply with the following tests to be successful.

1. It must admit a personal approach of the suggester to the Manager. The suggestion box is a psychological deterrent, and a shops committee—in the light of recent experience—is not the best medium for approach. All workers do not trust the committee and the jealousy between "unskilled" and craft labour has a deterrent effect on the former.

2. It must provide a measure of continuity of reward. Half the savings achieved in manufacture as a result of the suggestion over a period of six months from its actual adoption in work, forms a satisfactory basis.

3. Special provision for reward must be possible for larger proposals such as involve the registration of a design or a patent, and it must clearly be understood that the worker's rights are preserved in such a case.

One other British method of obtaining co-operation exists in the formation of Whitley Shop Committees. Much good will follow from this course but they require the personal leadership of Managers who have studied and realised the scientific basis of modern management and who are able to explain these principles to their foremen and the committee. Then in the course of time, by educative effort, we may hope for the intelligent co-operation in the control of the industry which many thinkers hold to be indispensable and inevitable.

The fourth principle—the equitable division of responsibility.

In every walk of life, one of the most frequent

causes of inefficiency and friction is the incorrect definition of functions. Under this head we have in the first place overlapping, two or more parties attacking the same objective at the same time, with the resultant inevitable clash of interests; jealousy and bad feeling are at once engendered and one or the other party is clearly wasting time. But another evil resulting from this defect is the shirking of responsibility and the transfer of blame when matters go wrong. This is a most fruitful source of waste and of friction. Waste occurs because the higher placed man declines to take the steps or else ignores those which are necessary to be followed in order to achieve the best results, and friction occurs because when things go wrong (as they inevitably must when responsibility is successively offloaded on to the man who can offload it no further), the blame is passed down in an obviously unjust manner. So we find in factory after factory that instructions are issued and passed down until it is invariably "up to" the workman to pull the employer out of a hole. A job is hurled at a workman; he receives an incorrect casting and a faulty drawing; he is expected to turn out a perfect article with an incomplete equipment on an inadequate machine tool. If the work is delayed while the man persuades the smith to forge a special tool, or if the time taken is too long, the blame is thrust down to the worker, whereas the blame should obviously be fixed much higher up. The whole trouble is the result of lack of prevision, and this again is due to faulty division of responsibility. Obviously this is not the way to obtain the best productivity from the worker.

Taylor realised this and his proposal was to divide

many of the functions of management among eight "functional Foremen," the basic idea being that these eight men should not control the worker (with the exception perhaps of the shop disciplinarian) but should help him. Thus on the preparatory side he established four foremen whom he styled the Speed boss, Instruction card clerk, Order of Work clerk, and Time and Cost clerk. On the executive side were the Gang Boss or Leader, the Inspector, the Disciplinarian and the Repair Boss. It is evident that such a division of function relieves the worker of all worry which is so frequently attached to his work under old fashioned management, but it also shows how sadly overburdened the average foreman must be and that this offloading of responsibility is only too natural and even necessary.

This devolution of the functions of management is the keynote of the Taylor System in America, but it will not work in this country. Here again we have to deal with the psychology of the British workman. He won't stand eight bosses, he wants to know exactly to whom he is responsible and he resents the fact that after all, the eight bosses being merely helpers, the blame will reach him in the long run.

Devolution of functions must take place in modern management, but it must be carried out correctly with due regard for the individual. In modern British management the foreman is the most important unit. He is a unit of management with clearly defined functions and all our system of functional organisation should be directed to helping him. The foreman is responsible for the leadership of his men and for the improvement of their craft skill. His is the respon-

sibility of maintaining the high standard of the human element of output and therefore he is the man to be aided by a specialist staff.

This then is the keynote of British Scientific Management. Responsibility must be adequately shared, the management through the specialist staff maintaining a correct flow of raw material, adequate equipment, efficient machinery and determining the best way to do the work; the foreman keeps his men interested and encouraged to improve, and maintains the quality of the output; the workman's share is the maintenance of a high degree of skill, the intelligent following of the instructions which show the way to maximum efficiency and the suggestion of improvements in the work on which he is engaged. Each individual has his function clearly defined, no overlapping, responsibility fixed and the spirit of "Help the Other Fellow" fostered.

Now what can we conclude from this examination of Taylor's principles? In the first place, Taylor's principles are as true to-day as when expounded for the first time. They are founded upon common sense and profound study and yet they are so obvious that the great wonder is that they are not universally adopted. But their adoption means the shouldering of responsibility by the management and it is this disinclination that must be overcome, by education, before a start can be made. It is this disinclination which leads management to follow the elusive trail of partial success which I have shown to be so full of danger.

Next it must be admitted that Taylor's principles form the basis of a science, the science of management, and that, applied in a manner suitable to the carefully

studied conditions of industry in this country, they contain the germ of a truly humane spirit in industry, the spirit which sets out to benefit the community by providing service at a low cost, to benefit the worker by elimination of overstrain and by adequate reward for task achieved, and to benefit the employer by providing an adequate return on the capital which provides the stabilising power of continuity of trade.

Finally, it must be agreed that Taylor's principles are practicable in this country, that their complete acceptance and application along the lines I have laid down does provide a complete solution of the problem of the increase of production.

PART III.

LECTURE V.

Vocational Diagnosis in Industry and at School

By CYRIL BURT.

INDIVIDUALS differ greatly in their fitness for different callings. It is impossible to conceive Keats as the successful organiser of an imperial army. It is difficult to imagine Kitchener as the author of the *Ode to a Nightingale*. The peculiarities that we readily recognise in instances so extravagant are repeated on a smaller scale in cases less extreme,—in the shop, in the office, and in the factory. One type of man is fitted for the mental work; and another for manual work; a third for nothing but gross physical labour. And within these three broad types innumerable cross-divisions and sub-divisions may be distinguished. Some take best to an outdoor life, others to an indoor; some to a roving life, others to a sedentary. Again, one man is most at home in dealing with persons; another in dealing with machines; a third in dealing with papers and books. Such distinctions are evident even to a layman. Other differences there are, less

conspicuous, but for the choice of employment no less crucial, which defy detection except by special scientific methods, methods as elaborate and technical as those which the medical officer for an insurance company will use in examining an applicant for a life policy. Obvious or obscure, all such differences are largely the expression, more or less indirect, of an inborn constitution, of an endowment that nature bestowed at birth, and which nothing during life can eradicate. To send the bookworm into the fields, to tie the wanderer to an office desk, will not make the one a good farmer or the other a good clerk. More probably it will ruin both the men and the work.

Hence, in the interests of industrial efficiency, it becomes imperative to find the best man for every task and the best task for every man. This is the essential problem of vocational diagnosis. By vocational diagnosis, therefore, may be understood the discovery and measurement by scientific methods of those special mental qualities in virtue of which a given individual is adapted for one occupation rather than for another.

Under other names and in other guises vocational diagnosis has already been adopted for a limited number of employments. The examinations instituted by Universities and other bodies which must be passed before a man can qualify as a physician, the Board of Trade tests for colour-blindness, which are intended to exclude from certain posts on the railway or on board ship men blind to the differences between red and green and white,—these are familiar if crude examples of vocational diagnosis. But for most occupations even such tests as these, rough and unscientific

as they are, have never been applied. Instead, in selecting employees, various make-shift methods are preferred. That which is at once the most common and the most wasteful consists in engagement on probation. Men are accepted for particular occupations for no other reason than that the situations are vacant and that the men have applied. After a period more or less indefinite many resign and more are discharged, either because they have proved unsuited to the work, or because the work has proved unsuitable to their tastes. To fill their places others are engaged; and they are engaged in the same blind and undiscriminating fashion. It would be hard to concoct a plan less economical. If this method could be universally superseded by some simple preliminary examination—even an examination so limited and so imperfect as that which a lawyer, an accountant, a navigating officer or an engine-driver, has to pass—the saving, alike to employers, to employees and to the whole community, would be enormous.

A few years ago figures were published by an American investigator which demonstrate the magnitude of this waste.* In the factories investigated, during the course of a single year six times as many men were engaged as were necessary to provide the permanent increase in the roll. In twelve factories nearly 43,000 men were engaged; and of these nearly 36,000 were discharged before twelve months had expired. The cost of engaging a single man was variously assessed at from 30 to 200 dollars. Doubtless other factors besides vocational unfitness were

* Alexander, M.—*The American Machinist*, 1895, August.

operative in many of the rejections. But making full allowance for these, a vast proportion of the entire sum,—nearly four million dollars in all—could have been saved, had it been possible to engage the right man at once. The plan, or planlessness, of first trying many individuals for a probationary period, and ultimately retaining only the fittest, must have cost each firm some thousands of pounds in a single year.

The value, then, of vocational diagnosis can hardly be disputed. Qualifying this value, there are, of course, certain obvious limitations. In taking up a given trade, aptitude for that trade is seldom the sole ground. Preference, opportunity, place of residence, the wages offered, the prospects promised, the relative number of situations vacant,—factors such as these are often decisive. During the War, for example, many individuals were forced, and sometines rightly forced, to undertake occupations for which they were deplorably ill adapted. And in other emergencies, personal as well as public, special considerations sometimes of necessity outweigh those of natural fitness. Nevertheless, of all conditions, suitability is certainly the one which works most for economic towards efficiency, and conduces most towards social harmony and individual content.

Granting, then, that vocational diagnosis would be profitable, we have yet to enquire whether it is possible. Here, as in so many other matters, what before the War seemed impossible has been, under pressure of military necessity, not merely accepted as feasible, but also accomplished in fact. In England during the last five years the methods of science have been applied to vocational selection, both in the factory and in the

training camp, with no small measure of success. An urgent need was the discovery of men with special qualifications fitting them for special tasks. Under the Air Board, tests were elaborated to estimate the suitability of an airman for duty either as a pilot or as an observer. Under the Admiralty other tests were devised for hydroplane operators in the anti-submarine campaign. Men were chosen to undergo special training in the detection of hostile sounds,—for example, those emitted by the engines of enemy submarines or aeroplanes. The candidates were first tested for various capacities,—for keenness of hearing, for accuracy in recognising the pitch, quality, rhythm and location of sounds, and for other more general qualifications. Unsuitable persons were rejected. The introduction of such tests at once improved the type of man sent forward, shortened the period of training, and increased the efficiency of the work subsequently performed. For the intelligence service it was found desirable not only to train men, but also to examine men in special abilities of numerous kinds—in the power to follow a given route in the absence of obvious landmarks, in the power to observe objects of various colours and contour, and in the power to gauge the number and arrangement of bodies of men variously grouped. By these and many other innovations the value and practicability of occupational tests was unimpeachably established. At the same time, the absence of such tests elsewhere proved as calamitous as their introduction here proved successful. As a result of the general interchange of occupations entailed by the War, many found themselves in places for which by endowment or training they were entirely ineligible. Sifting and

sorting there was little or none. And there are few who cannot personally testify to at least one case in which such unfitness produced a grave loss of time, of material, and even of life.

Such then, or nearly such, are the possibility, the value, the nature, and the limitations of the scientific diagnosis of vocational aptitudes. What science is to undertake the task?

From the most mechanical form of so-called physical labour—that of the navvy or the dock-labourer—up to the most sustained and complex application of intellectual power—that of a business organiser or scientific investigator, a Lloyd George or a Lister, a Kitchener or a Kelvin—all forms of human work involve a mental aspect. In a civilised community the mental aspect is, indeed, predominant. Hence, the diagnosis of vocational fitness consists very largely in an analysis of the individual mind. It is, in fact, a department of individual psychology.

Individual psychology is the youngest branch of the youngest of the sciences. Psychology—the science of the mind—is as yet in its infancy. It is still preoccupied with abstract questions regarding the general operations of consciousness as such. Two-thirds of the current text-books, four-fifths of the current experimental courses, are engrossed with processes of sensation,—the acuteness of the eye, of the ear, and of the skin. And the rest of the books and courses treat mainly with the normal laws of association, memory and perception. To age and to sex, to heredity and to environment, text-book psychology is still very largely indifferent. Yet age must alter both skill and character; sex must affect both instinct and

emotion; a bad heredity will subvert the soundest intellect and a bad environment may annul all efforts of training or tuition. Each must profoundly modify the industrial capacities of the individual.

From time to time, however, even the arm-chair psychologist has been led to note the effect of such conditions upon mental processes; and the laboratory psychologist has constantly been diverted from the abstract study of the mind in general, and attracted to the special peculiarities of the individual minds which offer themselves for his experiments. Hence has grown up a new psychology,—the psychology of individual differences. Owing largely to the accessibility and simplicity of the material, the minds of children have, in this respect, been studied most intensively; and the study has been fostered by the increasing demand for an individualised type of education. More recently still, the study of mental abnormalities—particularly of such neurotic disturbances as those induced by shell-shock and war-strain—has reflected light upon the temperamental side of individual personality, much as educational psychology has reflected light upon the intellectual side. Finally, inspired first and chiefly by the leaders of so-called scientific management in business, encouraged later, particularly since the War, by the interest of many large American firms, psychological investigators have attacked the problem of vocational guidance expressly and directly. Researches carried out in the psychological laboratory at Harvard University, and the suggestive book* published by Hugo Münsterberg, the

* *Psychology and Industrial Efficiency*, 1913.

late Professor of Psychology at Harvard, have aroused the general attention both of academic psychologists and of business men. And such institutes as the Carnegie Institute of Technology at Boston have appointed professional psychologists to carry out investigations into vocational tests and to apply the results to practical issues.

An early experiment in this direction provided, and still provides, a striking proof of the utility of psychological tests in industry. In an American factory, manufacturing ball-bearings for bicycles, one hundred and twenty girls were employed to inspect steel balls. The balls were examined for flaws in a strong light; and those observed to be defective were rapidly picked out by a hand magnet. For such work the essential qualifications are manifestly accuracy and smartness in observation and in reaction. These are both mental functions. To measure them the psychologist has long employed a precise and delicate method of measurement. In the laboratory, with an electric stop-clock or chronoscope a man's " reaction-time," (or " personal equation," as formerly it was termed), can be measured in thousandths of a second; large differences in speed are commonly discovered. Accordingly, this test was applied to the girls. The slowest observers, intelligent and industrious though they were in many instances, were dismissed or transferred to more suitable employment. It was finally found that thirty-five very quick observers could do the whole of the work formerly done by one hundred and twenty. Further, it became possible to reduce their hours of work from 10½ to 8½ hours per day, and to give two days' holiday per month. Efficiency was thus main-

tained at its highest level. As a result, the accuracy of the work at the higher speed was 60 per cent. greater than at the lower speed. Output was increased by over 240 per cent. Wages were increased by 100 per cent. And there still remained an increased margin of profit due to the large diminution in the cost of producing perfect balls.*

In England the interest in vocational diagnosis has crystallised into practical shape only during the past few months. It is now making rapid headway. A well-known and well-advertised institute of mind-training has recently opened a vocational laboratory. Two large general stores in London have appointed a psychologist. Two schemes have been framed for an Institute of Industrial Psychology, to be organised under the direction of competent experts, and to be attached either to a psychological laboratory of a University, or else to a government department. Meanwhile, in psychological laboratories, in elementary schools, in trade schools, in apprentice schools and in technical institutes, several investigators have already attained definite results by their researches upon vocational tests.

Investigations upon vocational guidance follow two complementary lines of approach. They may start with the occupation, and study its requirements; or they may start with the individual, and study his aptitudes. They may ask: which is the right man for the job? or, which is the right job for the man? The former is the easier and the commoner procedure.

* Taylor, F. W.—*Principles of Scientific Management*, New York, 1911. pp. 85-97.

I.

In studying the special qualifications required for particular occupations, the methods adopted fall into four groups. We may term them respectively the methods of "sample" tests, "analogous" tests, "empirical" tests, and "analytic" tests. In the "sample" test, the operation actually measured is a typical example of the work actually to be done. In the "analogous" test the operation measured is not identical with the work to be done, nor even with a portion of it, but is merely similar to it psychologically. In the "empirical" test the operation measured is chosen not for its apparent identity with or similarity to the work to be carried out, but simply because in actual practice it has been proved an effective test, although the reasons for its effectiveness are perhaps neither obvious nor clear. In the "analytic" test an endeavour is made to resolve the work to be done into its elementary psychological constituents.

(1). Of these methods the commonest is that of the "analogous" test. Some brief artificial task or test is contrived which appears to demand activities resembling the vocational activity. Such a test endeavours to reproduce on a small scale a situation similar to that involved in the real life of the worker. The similarity, however, must be internal or subjective rather than external and superficial. The test-situation resembles the actual situation in the sense that the former seems likely to call forth the same mental processes as are required by the latter. Outward similarity is valueless. In naval courts where ship collisions are demonstrated by means of miniature

models, the most experienced navigator is apt to become confused; the perceptions, the interests, the decisions aroused by the toy ships sliding on a piece of glass are not those excited by real vessels at sea. It is the inner attitude of the mind, not the external shape or colour of the objects, that the tests must transplant into the laboratory.

The following experiment illustrates both the nature and the limitations of the "analogous" test. In the Harvard Psychological Laboratory, Professor Münsterberg* tested motor-men for an electric car service in the following way. A long square-ruled card represented a street; two parallel lines down the middle represented the tram-rails. Figures were marked upon certain squares to indicate objects on the road,—"1" represented a slow-moving pedestrian, "2" a horse moving twice as fast, "3" a motor-car moving faster still. Figures moving across the track were coloured red; those moving parallel with the track were coloured black. For reference each square along the track was lettered A to Z. The examinee was then required to name, as fast as possible and in order, the squares threatened, as it were, by the figures on either side.

In carrying out this test the candidates reported that they had the same feeling of tension and watchfulness which they experienced on the platform of the car when driving down a crowded thoroughfare; and the marks obtained showed "a far-reaching correspondence between efficiency in the experiment and efficiency in the actual service."

* *Loc. cit. sup.*, p. 68, *et seq.*

To various other callings, such as typesetting and navigating, the principle of the analogous test has been applied with an equal degree of apparent success. Nevertheless, I believe that the results have been misinterpreted. From experiments on the effect of special practice we know that improvement gained by prolonged experience and by repeated exercise in one field is seldom transferred to another field in any large degree, however closely the second may resemble the first. On the other hand, we do know that the same central factor—general intelligence, as it is usually termed—enters more or less intimately into all fields of mental activity. Hence, I infer* that the test for motor-men appears successful, not because it picks out those with special aptitude for discriminating objects on either side of a track according to the speed and direction of their movement, but because it picks out those whose general intelligence at any task and at all tasks was appreciably above the average. Car-driving requires not only a special form of discrimination, but also general intelligence. Similarly, the test employed requires not only a special form of discrimination, but also general intelligence. It is extremely unlikely that the special form of discrimination exercised in observing red and black figures is psychologically the same as the special form of discrimination exercised in driving a car. The common factor, therefore, is not any one form of discrimination. It is general intelligence. But unfortunately for the claims of this particular test, this common factor enters, not

* I have verified the inference by experiments upon children and young adults. The test gives a fairly high correlation with intelligence, the coefficients ranging between .43 and .61.

only into car driving, but into almost every other form of work. To this criticism a paradoxical result, noted incidently by Münsterberg himself, lends considerable support. Among all the motor-men tested there were none whose marks for speed and accuracy reached even the poorest score obtained at the test by the research students of the Harvard Psychological Laboratory.

The inevitable co-operation of this general factor is apt to vitiate almost every test of specific aptitude when the test is taken at its face value. The selection of children for trade schools yields an excellent illustration of this difficulty. At the age of ten and a half every child in a London County Council school, who is not demonstrably backward, sits for a junior county scholarship examination. The successful candidates are promoted to secondary or central schools. Since the work in such schools is traditionally scholastic rather than technical or manual, technical or manual tests have no part in the examination; the examination consists solely of papers in scholastic subjects such as arithmetic and composition. Three years later the children remaining in the elementary school may sit for a second examination for trade scholarships. The successful candidates are transferred to trade schools. It is then found that very few children capable of doing first-rate technical work are sent forward. Enquiry discloses one very significant reason. First-rate technical work requires the combination both of first-rate general ability and of first-rate special aptitude for technical work. Now a child of first-rate general ability, even though his special aptitude for scholastic work is poorer than his special aptitude for technical work, is likely, solely in virtue

of that general ability, to do creditably in the scholastic examination set for the junior county scholarships; for success in that examination depends upon general ability quite as much as upon special scholastic ability. Hence, such a child will at the earlier age have been transferred to a secondary or central school. When the time comes for the examination for trade scholarships only the duller children are left to compete.

The common factor, then, of general intelligence tends to make both special scholastic examinations and special vocational tests appear more successful than they really are. Indeed, in what we have termed "analogous" tests, the analogy between the test-activity and the industrial activity is seldom a genuine one. The mental attitude evoked by the former is identical with that evoked by the latter only when the analogy is so close as to amount to virtual identity. The test then ceases to be an "analogous" test, and becomes a "sample" test.

(2). In the "sample" test, as I have termed it, the candidate is tested at an actual specimen of the work which, when engaged, he will be required to do. This procedure, in my opinion, is by far the most trustworthy for immediate practical adoption. Of the psychological nature of industrial operations we know at present virtually nothing. Of the psychological characteristics of different types of workers our knowledge is hardly any more extensive. Of the intrinsic psychological nature of laboratory tests we are, indeed, somewhat better informed; but we are still lamentably ignorant both of their relations to one another and of their affinities with industrial operations. One of the things we do know is this: namely, that,

apart from the influence of general intelligence, to infer from a high degree of ability in one kind of task, or from a large amount of experience in one kind of task, the existence of a high degree of ability in a second kind of task, even though the kind be not very dissimilar to the first, is always precarious and usually misleading. It follows, therefore, that an applicant should be judged by his performances at the very tasks we engage him to carry out. Test the typist at the typewriter, not with a pen-and-paper test. Test the car-driver on a real car, not with a laboratory model. Never gauge a man's ability for one special job by testing him at another.

This maxim is flagrantly contradicted by our traditional procedure in selecting men for the highest posts in the land. We elect men to be members of Parliament according to the strength and fluency of their rhetoric. We choose administrators for the Indian Empire by an examination comprising Greek and Latin verse. The success of the plan, a debatable success it must be granted, is due solely to the fact that for all four functions a high degree of general ability is essential. Its disasters are due to the utter disregard of the need of specialised ability for specialised work.

The principle of the "sample" test is the principle most commonly adopted by any employer who gives his prospective employee some rough and ready test. He will ask the clerk to balance an account taken from the ledger which he will actually be desired to keep. He will ask the stenographer to take down and transcribe a business letter dictated at his fastest speed. A carpenter he will ask to dovetail together two pieces of wood; to the plumber he would give a corner of a

pipe to boss or a metal joint to wipe. Indeed, the whole system of engagement upon probation—a system which I have already deprecated—is little else but an application, upon a large, crude scale, of the "sample" type of test. Where then does the science enter in? Where are the services of the psychologist required?

The psychologist can do for the employer's practical test what he has already done for the scholastic examinations of the teacher. He can standardise the test procedure; and he can standardise the test-results. And by this twofold standardisation he can make the procedure at once most rapid and more accurate. For generations teachers have been examining pupils in the various subjects of the school curriculum. But recently the psychologist has shown that, considered as a scientific process, the ordinary school examination is vitiated to an incalculable extent by irrelevant and unnoticed factors; scientifically regarded, it is about as accurate as the milkman's method of estimating a pint of fluid. The inevitable pitfalls that await the layman when he endeavours to determine mental capacities, or to measure mental attainments, have to be indicated again in the case of the scholastic examination; and, before that examination can be utilised for scientific purposes, its defects must be minutely analysed and carefully eliminated.

Upon the employer's tests the same refinement can be carried out. The procedure, in the first place, must be regulated according to the recognised canons of psychological technique.* For example, if the first

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* These will be found excellently summarised in Whipple's *Manual of Mental and Physical Tests*, Vol. I., Chap. ii.

applicant types one passage and the next applicant types the sequel, it is impossible to compare the two results with any measure of validity. The test set to the candidates must always be the same. Further, the instructions must always be identical; and the phrasing of those instructions must be carefully prepared beforehand. And so with the less obvious details that appertain to all testing of psychological activities. Secondly, the results must be standardised as well as the procedure. In school subjects it is only recently that teachers have discovered what is the average rate of reading, writing, or calculating at the various ages of school life; and what particular rates at those ages constitute symptoms of superior merit, or of definite deficiency. Similarly, in shorthand and typing only the roughest standards of attainment have hitherto been recorded; and for most commercial and industrial operations the supervisor or the foreman trusts to a vague general impression based on his own private observation or personal experience. These are plainly inadequate. An efficient test demands the discovery, not only of a trustworthy and comparable technique, but also of trustworthy and comparable "norms"—measures, that is to say, of superior, tolerable, or inferior performances.

We need, therefore, to work out standardised "sample" tests for each of the more important industrial processes. But our investigations must not rest here. Were the "sample" test the only type of vocational test available, vocational diagnosis would be a cumbrous affair. The drawbacks are obvious. In the first place, exact examples of all the important industrial processes can never be reproduced

by the psychologist in his laboratory. It is, I presume, largely for this reason that the vocational psychologist has hitherto for the most part elected to develop and adapt his own traditional tests rather than to develop and adapt the "sample" tests favoured by the employer. This, however, is not a grave objection. It merely means that in the future the psychologist must enter the workshop, and carry out his experiments in close co-operation with employers or with their works managers—a change of arena that will benefit both parties. Meanwhile, until he is invited to do so, there are other establishments peculiarly fitted for experimental investigations upon vocational tests,—the technical institutes, the trade schools, and (where they exist) the schools for apprentices. Here—all unconscious it may be, of the wider significance of their daily judgments and their routine examinations—the teachers have already attacked the problem of vocational diagnosis. In the inevitable endeavour to estimate their pupils' progress, they have been forced to devise tests which are really nothing else than rough measures of vocational aptitude and vocational attainments. Research, therefore, might well begin by standardising the tests in vogue, and by refining the methods of observing and examining the pupils, within these various schools.

There remains, however, a profounder objection to the use of the unsupplemented "sample" test. The "sample" test is generally apt to prove a test of acquired attainment rather than a test of natural aptitude. In many cases, to be accurate and just, it presupposes a period of preliminary training which shall be approximately the same for all examinees.

The employer may test the trained clerk in shorthand and typewriting; but with the untrained pupil such a test would be useless to determine at the outset whether he was fitted to undertake such specialised and speedy finger movements as a training in typing and stenography demand. Often, too, in actual office work the younger ill-trained clerk will rapidly outstrip an older duller colleague, who, in virtue of a better training or a longer experience, has perhaps made the better display at the original interview. The influence of practice is clearly illustrated by the examinations for the postal services. For long, in addition to the more academic tests of the civil service examination, the post-office has employed the method of "sample" vocational tests before confirming the engagement of a probationary employee. The postman is required to read a series of ill-written addresses: the sorter to distribute a hundred dummy envelopes in piles according to their destination: the telegraphist to transmit messages by the telegraph key at the rate of thirty words a minute and to receive at the rate of twenty-five. But the examination in telegraphy can be applied only at the end of a period of training, during which both time and money have been wasted on the innumerable candidates who develop telegraphists' cramp or exhibit other disqualifications. The sorters' examination is itself treated merely as a check upon the reports of the supervisor or as a safeguard against complaints about such reports; the supervisor's personal observations during the probationary period are legitimately regarded as of far greater value than a few minutes' artificial testing. Finally, almost any person with an elementary school education

can practice himself in the reading of handwriting until he can pass the postman's test. In itself, therefore, a single "sample" test of this description will usually fail to diagnose natural ability or inborn aptitude apart from differences of training.

Accurately to diagnose natural ability the "sample" test must be applied first at the beginning of the training period and then again at the close, and if possible at regular intervals throughout its course. The measurement will be based not upon the absolute test-results, but upon the relative extent of progress made with a standard amount of practice, in a word, upon the curve of improvability. Such a procedure is both cumbersome and costly. It can be avoided only, if it can be avoided at all, by discovering mental tests for natural capacities of a more elementary or fundamental kind.

(3). For most of the elementary functions of the mind, at least in its intellectual and practical aspects—for movement, for sense-perception, for attention, for memory, for learning, for association,—we now possess reliable psychological tests.* Many investigators, therefore, have applied one or more of these standardised tests to a group of employees; and have compared the results of the brief psychological experiment with the actual merits of the employees, as assessed after careful and prolonged observation. If the two estimates closely correspond, it is inferred that the experiment selected will provide an efficient test of actual merit. In comparing the efficiency of a number of different tests it is desirable that the

* A description of the most useful tests will be found in Whipple's *Manual of Mental and Physical Tests*.

correspondence of each with actual merit should itself be measured in quantitative form. For this purpose the statistical device of "correlation" is usually employed.

Often the procedure is purely empirical. The scientific investigator prefers tests chiefly for their known reliability; and, for research purposes, selects them, so far as resemblance to vocational duties is concerned, purely at haphazard. He then determines their diagnostic value, not on the ground of *a priori* similarity with the vocational work, but rather according to the correlations empirically obtained, that is, according to the extent to which the test-results agree with independent estimates of ability at the work. A French investigator,* for example, tested a group of typists, good, average and inferior, with a large and miscellaneous set of laboratory tests. He found that the examinees who were superior at typewriting were on the average superior also in tests of memory span, sustained attention, tactile and muscular sensibility, and equality of strength in the two hands. Here different tests were applied to persons following the same occupation. A converse procedure is to apply the same test to persons following different occupations. Thus, another investigator† used a "substitution test," in which certain symbols have to be substituted for certain others according to a prescribed code or key. The test was set to various groups of commercial

* Lady, J. M.—"Les conditions psychophysiologiques de l'aptitude au travail dactylographique." *Journal de Physiologie*, 1913.

† Lough, W. H.—"Experimental Psychology and Vocational Guidance." *Proc. Second Conference on Vocational Education.*

students. The results differed in the different groups. It was found that the test-records showed a very high correlation with ability in shorthand and business correspondence, but no significant correlation with ability in mathematics or German. For the first two occupations, therefore, the experiment in question was recommended as constituting an effective test.

Hollingworth, one of the leading authorities in America upon vocational psychology, believes this "miscellaneous, random, and purely empirical method .... to be the most promising experimental procedure for the immediate present, and perhaps for some time to come."*

(4). It is clear, however, that if the collection of tests is sufficiently comprehensive and systematic, surveying eventually all the chief, or at least all the relevant, elementary activities of the mind, we shall gradually achieve a thorough psychological analysis of the particular trade-process under investigation. Thus, instead of testing the particular industrial capacity as a whole—the procedure adopted both in the "analogous" tests and in the "sample" tests—we shall analyse that capacity into its component mental functions, and test each of these in isolation. This is the method attempted by what I have termed the "analytic" tests.

The most complete and thorough programme of this sort is the scheme elaborated by Professor Seashore for testing musical ability.† He proposes to measure

* *Vocational Psychology*, p. 119.

† *University of Iowa Studies in Psychology*, No. VII. (Psychological Monographs, Vol. 25, No. 2), 1918. Cf. also *Psychology in Daily Life*, by the same author.

one by one all the fundamental qualifications indispensable for a good singer; among other characteristics, his power to discriminate notes according to their pitch, their loudness, and their timbre; his power to produce notes according to the same and other characteristics; his power to remember and reproduce in imagination musical tones and phrases; his emotional reaction to and interpretation of music of various kinds. These capacities in turn are to be reduced to typical performances, most of which can be measured in quantitative terms by means of appropriate apparatus. For example, he declares that ability to change the voice by only 3 v. d. (vibration differences) is characteristic of the average person; by 0.9 v. d. is characteristic of good singing aptitude; by nothing less than 9 v. d. is characteristic of a person who cannot sing at all. In non-technical language, this means that a good singer, having sung middle C (the tone produced by a tuning fork vibrating 256 times per second) should then be able voluntarily and accurately to change the pitch of his voice to that of a fork vibrating 256.9 times per second (an interval equal to about one-thirty-fifth of that between C and D, the next note above it). Such ability is found in about three individuals out of a hundred. Fifty per cent. can execute a change to 259 vibrations, but no smaller change. The worst eight per cent. can execute nothing nearer than a change to 265 vibrations,—a change of about half a semitone. Other qualifications Professor Seashore and his colleagues are endeavouring to measure with the same precision; they propose to obtain typical norms and standards of performances in each and in all. In addition they have given

their enquiries a practical application. Surveys of musical talent have been made in the top classes of the schools in two cities of Iowa; and as a result some seventy children have been discovered possessing high native ability in music. Twenty-four of these have enjoyed no previous instruction; and all are being encouraged to develop their latent talents by musical studies.*

As applied to a vocation of a commercial type, the "analytic" procedure may be illustrated by another investigation of Professor Münsterberg. A well-known American telephone company invited him to enquire into the possibility of determining at the outset the mental fitness of switchboard operators engaged upon probation. During the first six months in the company's service, the operator works entirely under supervision; and, regardless of ultimate fitness and retention, is paid by the company during the entire period of training. At the end of half a year, more than one-third of those originally engaged either resign or are discharged. On an average the girls have to handle about 150 calls an hour; and, during the busy periods of the day, sometimes as many as 300. Those, therefore, who in virtue of their mental and physical constitution cannot attain a speed of five to ten calls a minute without undue effort are liable to excessive fatigue. Many eventually collapse with a nervous breakdown. Hence, vocational fitness is of extreme importance both to the company and to the girls themselves.

After carefully watching the work of the operators

* *Journ. Educ. Psych.*, VIII., 5, 1917, p. 321.

in the central office of the company, Professor Münsterberg concluded that to reproduce in the testing-room the operations at the switch-board would be inexpedient if not impracticable. Such a test, we may presume, would be successful, if at all, only at the close of the training period, not at its commencement. Consequently, he proceeded to analyse the actual operation of handling a call into its mental and physical elements; and to test each elementary activity separately. He inferred that about a dozen physical or mental processes, distinct and independent, were implicated in the work. Accordingly, the girls were subjected to a series of psychological tests. They were tested first for acuity of hearing and vision, and for distinctness of pronunciation. They were then examined, together, in class, for intelligence, attention, memory for figures, exactitude of visual space-perception, and rapidity of hand-movement. The class tests were supplemented by individual tests. For example, each girl was required to hit with a pencil various points on a sheet of paper at a rapid speed timed by a metronome,—a feat very similar to striking the holes in a switchboard with a plug. At the close the girls were ranked in an order of merit for each test; and the average order was computed.

It had been agreed that, at the end of three months' training, the company should endeavour to grade the examinees in a similar order of merit on the basis of their success in the actual duties; and group them respectively as unfit, average, and excellent. A little sceptical of the experiment, the company, unknown to Prof. Münsterberg, had included in the class a number of experienced operators and a few teachers from the

telephone school. These without exception appeared at the top of Prof. Münsterberg's list. Similarly, the girls who stood at the bottom of the list were, with one exception, eventually found incompetent by the company upon entirely independent observations. In the whole group of thirty examinees there were only three discrepancies between the predictions of the initial tests and the judgments founded upon the company's experience; and none of the discrepancies was sufficiently large to reflect unfavourably upon the psychological procedure.

These, then, are the main lines of research. These are the chief types of enquiry which the vocational psychologist has hitherto pursued. In effect, it will be noted, he has started by analysing the requirements of given occupations rather than analysing the capacities of given individuals. Individuals, of course, have served as subjects for the tests. But the primary interest has centred, not in the natural aptitudes of those individuals, but in the vocations at which they are with varying proficiency engaged. Throughout the real question at issue has been this: "what sort of man is the best man for this work"? not "what sort of work is the best work for this man"?

II.

The latter problem—the analysis of the needs of the individual—is an undertaking far more ambitious and far more neglected. Until science has moved to this second line of approach, the task of vocational diagnosis can never be established upon a satisfactory footing. Till then many of our verdicts must be purely

negative. We shall be rejecting a large number of our examinees as unfitted for singing, for telephone-operating, for ball-sorting, for motor-driving, and for whatever other careers our tests have dealt with; but we shall be leaving that number, apart from other efforts on their behalf, unsuited or unemployed. Accordingly, we must also review and analyse the capacities of each individual, with a view to classifying every one according to his vocational aptitude.

Carried to its logical conclusion such a plan would involve nothing less than a complete census of our psychological resources. In Mr. H. G. Wells' famous war novel, the German tutor tells Mr. Britling: "The English do not understand indexing. It is the root of all good organisation." The perfect organisation of an industrial community would entail this condition: every man, woman, and child should be indexed according to their mental powers. A national register of men of military age, a national enrolment of voluntary workers for the factory or for the land, a national survey of food supplies, a national census of coal,—to these and many forms of registration and of survey we have already become accustomed, as proposals if not as actualities. But the mental and moral resources of the nation are a far greater asset than its agricultural or mineral resources, or even its human resources regarded solely from the standpoint of physical fitness. Not only man power but mind power must be registered and mobilised. Only thus can we make the most speedy recovery from our recent sacrifice of wealth and of men.

The feasibility of a broad scheme of vocational testing is perhaps most convincingly demonstrated in

the experience of the army of the United States. Under the direction of the Division of Psychology in the Medical Section of the American War Department, recruits were tested by means of intelligence tests applied by specially trained personnel officers. By November, 1918, over a million and a half men had been tested in this way. The methods, the results, and their practical utility have since been described in an official pamphlet.* The object of the tests was threefold: to eliminate men whose low grade of intelligence rendered them a burden and a menace to the service, to discover those whose superior intelligence suggested their suitability for advancement, and to select men whose peculiar aptitudes suited them for special military duties. The examining staff of a camp were able to test, on an average, about 2,000 men a day, and to report the assessments to the Personnel Office within another twenty-four hours. These estimates, it is said, proved to be one of the most important aids in the rapid sorting of the masses of men in the Depôt Brigades. For rough purposes intelligence was graded in seven classes—from A. to D. And perhaps the most interesting table in the whole report is that which gives the grading of the commonest occupations, and displays them, ranked in a linear series, according to the average degree of intelligence exhibited by the individuals following them. The occupations, numbering between seventy and eighty in all, range from general labourers, cobblers and miners (averaging C–) through farmers, ostlers, barbers, bricklayers, cooks, bakers, blacksmiths,

* *Army Mental Tests*, Washington, D.C., Nov. 1918.

carpenters, butchers, plumbers, chauffeurs, policemen, telephone operators, electricians, musicians, clerks, mechanical engineers, nurses, typists, accountants, civil engineers, and medical officers—arranged thus in ascending order—up to army chaplains and engineer officers, the last two averaging A. Material for commissioned rank was found chiefly in the A and B groups. Men below C+ should not, it was stated, be accepted for training in Officers' Schools. Men rated below C were unsuited for non-commissioned officers; sergeants and corporals rated as C or lower proved unsatisfactory. Men of D and D– level could not understand written or printed instructions, and to give such individuals any but the simplest verbal orders, was found to be quite unsafe. "Altogether," the report concludes, "it has been thoroughly demonstrated that the intelligence ratings are useful in indicating a man's probable value to the service."

But general intelligence is not the only criterion of a good soldier. Special aptitudes and special qualities of character must also be taken into account. Hence, in addition to the testing of intelligence, the American Personal Department found it both desirable and possible to compile an elaborate card-index showing for every man his more specific qualifications. When, therefore, there was an urgent need for a person with a peculiar combination of talents,—for example, an officer familiar with the Russian and German languages, strong in physique, a good leader, of university culture, yet able to play certain specified musical instruments (a requirement that was actually made for a certain piece of intelligence work),—then the most suitable man could be located with a minimum of

delay. If, then, such a registration of men according to their occupational aptitudes proved feasible for the activities of war, surely we cannot deny that—in theory at least—it is also possible for the activities of peace. But how is it to be undertaken?

The survey, I would suggest, might easily be attempted through the mediation of the school. Already the teacher is discovering that, in the interests of the children's education, and quite apart from the requirements of their after careers, he must not only give them lectures and set them lessons; he must also study their individual dispositions and proclivities in order to adjust the lectures and the lessons to the peculiar needs of each. This is now done most systematically for the mentally deficient. In every special school a " progress-book " is kept for each defective child. In it, under prescribed headings, are periodically recorded the child's abilities, attainments, and temperamental peculiarities as they manifest themselves from term to term and from year to year. In many central schools the headmaster compiles a *dossier* for each individual pupil, to which he refers when the pupil leaves school or when later he is again approached for a testimonial of character or certificate of competence. In every school, whether special, ordinary, or higher grade, an elaborate register of cards is kept, one for every child, on which is recorded the results of a periodic medical inspection. What is done for the mental and moral characteristics of the defective and the supernormal, what is done for the physical and medical characteristics of every child in a Council school, should be done for the mental and moral characteristics of all.

There is already in existence the administrative machinery which, with certain modifications and extensions, might be made the basis or the model for such a survey. The machinery is embodied in a revised scheme of the after-care and juvenile employment experimentally adopted in the boroughs of London. Every child, as he leaves the elementary school, is briefly described upon a school-leaving form. The form is intended to give a confidential record of the child's characteristics—of his intellectual and practical abilities both general and especial, of his moral character, of his physical and medical characteristics, and of the economic and social environment of his home. The essential particulars are copied from this form on to a card; and indexed by the local association of After-Care Committees. With the assistance of the Juvenile Advisory Committee of the Employment Bureaux or some other agency, the child is recommended for an employment as suitable as can be found. Then, with the aid of voluntary visitors and club superintendents, he is supervised until he is seventeen or eighteen. The result of the supervision—his progress, his decline, his future education,—are reported and recorded at the office of the District Organiser.

Here, then, we have a basis—a scheme already working—for the registration of mind-power. At present the particulars in the schedules are filled in by teachers during the child's last few days at school in a vague and indefinite fashion: "conduct,—good"; "intelligence—fair." As a testimonial such a statement may be helpful; as a scientific guide it is worthless. The list of characteristics and aptitudes,

therefore, must be revised and defined in accordance with some more scientific "psychographic scheme." A uniform system of measuring or marking the various degrees of aptitude must be devised. Eventually, tests of mental ability and educational attainments must of necessity be provided. Tests, indeed, are already available for measuring ability in the chief scholastic subjects—handwriting, spelling, composition, reading, and arithmetic in its various forms; and by means of the improved versions of the Binet-Simon scale, general intelligence—the mental quality which in economic value is supreme above all others—can be rapidly assessed in both children and adults with considerable precision. For the subtler qualities of character and temperament—conscientiousness, honesty, reliability, leadership, enterprise, imagination, artistic sense, and so forth—the observations of a competent teacher, extending over a period of several years, will perhaps always prove more trustworthy than the results of experimental tests. With these modifications the cards should ultimately provide the data for a methodical survey of the human material available for industry in any given area; and should greatly further our ultimate object—the discovery of the right vocation for each individual and the right individual for each vocation.

I have myself endeavoured to make a survey of children's ability in a representative borough. In a published memorandum* the estimates were based upon the child's educational abilities. More recently

* *The Distribution and Relation of Educational Abilities*, P. S. King and Son, 1917.

the results have been checked by means of tests intended to measure inborn general intelligence.

Such a survey of children's ability answers a question which for the proper organisation of industry is of the utmost significance. How is ability distributed among the general population? Is it distributed like land or wealth, where those who have much are few and far between, and those are commonest who have little or none? Or is it distributed like physical characteristics, like height or weight, for example, where the average type is the commonest type and the dwarf is as rare as the giant? A glance at the figures obtained shows that, beyond all debate, the latter alternative is correct.* Ability is distributed in close conformity with what the statisticians call the "normal curve." It falls, scattered, like shots fired from a gun or sand emptied from a bucket, in accordance with the laws of "chance." And "chance," as the actuary of any insurance society will testify, is one of the most regular and predictable things that there are. It becomes possible by the aid of a simple formula to forecast for a given population the approximate number endowed with any specified modicum of ability, much as we calculate the number who will within the ensuing year most probably die. From this conclusion many corollaries ensue. I will indicate but one. Most employers, it would appear, conceive the dense medium as located towards the lower end of the scale of intelligence. They picture ability as distributed like wages. They do not realise that this poorer mass, performing the

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* See *loc. cit. sup.*, Table XIV., p. 32 and figure 5 p. 33. Also figure 7 p. 42 (for calculated distribution of educational ability among the child population of London).

meanest types of labour, contains numerous grades of inefficiency which should be sorted out with as much care as one sifts out, or should sift out, the more efficient.

The wide range of ability displayed among children of the same age is almost incredible. For practical purposes we may put it as equivalent to a range of about nine or ten mental years. That is to say, if we surveyed the whole school population of London, we should find that, at the age of ten, the dullest child was mentally equal to an average child of about five, and the brightest child mentally equal to a child of about fifteen. This total range it is convenient to divide into six sections or grades. (1) Children who are more than thirty per cent. ahead of their actual age we may designate "scholarship children." To call them secondary school children would be misleading, since the intelligence of fee-paying pupils may be of a much lower order. As a rule, before he can win a scholarship at the age of about ten, a child must at least reach the mental level of an average child of about thirteen ($10 + 30\% \times 10 = 13$). This scholarship group comprises the top one or two per cent. of the whole elementary school population. There are in London rather over three-quarters of a million children of school age. Nearly 90,000, therefore, leave school annually. Of these, between one and two thousand children will possess this highest grade of merit. Apart, then, from imported ability it is from among this annual quota of about fifteen hundred supernormal children that London has to find its candidates for posts requiring intelligence of the highest order. (2) Children who are

more than 15 per cent. but less than 30 per cent. ahead of their age we may call children of central school ability. They comprise the next 8 or 9 per cent. It is in this group that we should look for sound, solid, second-rate intelligence. (3) The next section is a large one. It comprises children who lie somewhat above the average, but do not rise above it by more than 15 per cent. of their age. (4) The fourth section is equally large. It comprises children who fall somewhat below the average, but do not fall below it by more than 15 per cent. of their age. Together these two sections constitute the dense medium of moderate ability. (5) The fifth section will include those who are below the average by between 15 and 30 per cent. of their age. At the age of ten they still lag behind at the level of the average child of seven or eight. At the age of leaving school (fourteen) they have struggled to the level of ten or eleven, equivalent to Standard IV. or V. These we are beginning to designate (in a somewhat technical sense of the word) "backward" children. Throughout the country there is a general desire to establish for such children special classes and special "intermediate" or "backward" schools. For complicated paper work they will never be fit. But for manual work requiring a low-grade of skill, and for mechanical and routine services, they are sufficiently fitted. (6) Lastly, the bottom 1½ per cent., who are backward by more than 30 per cent. of their age, are, during their school career, certified as mentally deficient, and committed to a special school. Although stigmatised as defective while of school age, nearly two-thirds of these children pass out into the world, and earn their living with more or less success. In a benign

environment, an individual can maintain himself and support a family fairly satisfactorily, if his mental level does not fall much below that of a child of about seven or eight,—the level of the poorest types of domestic servants and casual labourers whom I have tested.

These, then, are our six grades of intelligence. The first two comprise the top 10 per cent. of our school population; the next two—the "dense medium"—the middle 80 per cent.; the last two the bottom 10 per cent.

A survey of adult ability would probably yield a parallel classification. Upon a small scale I have endeavoured to apply tests of ability to individuals representing typical vocations, usually the adult relatives of the school children I have tested. Adopting the same lines of demarcation, and expressing them as before in terms of "mental ratios" (ratio of ability measured in mental years to actual age measured in calendar), we obtain six analogous vocational categories. In each of the several categories the proportion of adults is not dissimilar to the proportion of children in each of the several grades. To begin with, therefore, the problem of vocational guidance will consist in directing the child, according to his grade of ability, into a vocation belonging to a corresponding category. We can, for example, distinguish (1) the professional and the more responsible administrative positions (mental ratio, 130-150% or more). To these, children of the scholarship grade should speedily be promoted. (2) Next to these we may place administrative and clerical posts of intermediate grade and a large number of technical posts (mental ratio, 115-130%). To these,

children of the central school grade should sooner or later rise. (3) Below these fall most of the ordinary commercial positions, including those filled by the majority of persons engaged in trade upon a small scale (mental ratio 100-115%). Such positions the superior half of the " dense medium " will obtain. (4) Fourthly, there is a large mass of skilled labour (mental ratio 85-100%,—although many individuals from this category markedly surpass even those in the foregoing). To these skilled occupations the remainder of the " dense medium " may aspire. (5) A fifth category comprises unskilled labour (mental ratio 70-85%). This category resembles in general level, though in actual numbers it somewhat exceeds, our backward type of child. (6) Finally, the high-grade borderline defective usually drifts into casual labour of various types (mental ratio 50-70%). For the indubitably defective adult (mental ratio below 50%) there is, or should be, nothing but life in an institution.

The foregoing parallel is cited rather as a rough illustration than as a scientific conclusion. The vocational categories as enumerated above would in actual fact overlap enormously; and the limits of each are too narrowly defined. On the other hand, the psychological grading is too coarse; and in practice far more than six levels could be discriminated by a test of intelligence. Nor is intelligence the sole criterion. Character and specific aptitude may be of equal moment. For example, the average type of child is, as we have seen, the commonest type of child; the "dense medium" includes four-fifths of the entire population, all falling well within the middle third of the total range. With these, vocational recommen-

dations will depend, not so much upon the degree of intelligence—which by hypothesis is approximately average—but rather upon special talents and peculiar qualifications. To discover such specific aptitudes among those whose general ability is approximately average, appropriate tests are urgently needed. Here, indeed, is one of the most opportune spheres for expert discrimination.

To a school survey for vocational ability there is a common objection, which must here be briefly faced. How far can a man's powers be judged during childhood? It may at once be conceded that such predictions cannot claim infallibility. The game of "cheat the prophet" is one that Nature loves to play. There are backward children who bloom late. There are precocious youngsters whose promise of a brilliant maturity fades early. In all there are special tastes and talents which seldom ripen until the approach of puberty. Nevertheless, these instances are exceptions. With general intelligence there is a distinct and discernible tendency for approximately the same mental ratio to be preserved throughout the period of development. A child who at six has a mental age of three and therefore a mental ratio of only 50 per cent., will at the age of sixteen exhibit, as a rule, the same mental ratio, and therefore attain a mental age of only 8. Indeed, it is a common saying among medical officers, that a defective who subsequently proves normal was a case of mistaken diagnosis. The same principle appears to hold good—although its existence is not so well attested—in the higher ranges of ability.

The persistence of relative capacity and incapacity is best demonstrated for scholastic abilities. I have

kept under observation several groups of school children, normal, supernormal, and defective, for over six years: and I have annually tested their relative attainments. Consistency is the rule. Cases of irregular mental development exist, and, as time goes on, accumulate. But they are exceptional. Year by year, the correlation of the latest order of merit with the initial order tends to decrease: but even by the end it appears appreciably high, on an average, .43. Prediction is thus legitimate.

American studies similarly demonstrate that school careers accord with University careers and University careers with careers in after life. One investigator* studied the histories of over 1,600 graduates from Wesleyan University. They were arranged in three groups. First, the "honour" men, 140 in number; secondly, those elected to a famous academic society (Phi Beta Kappa) on the basis of high scholarship; and thirdly, the remainder. He then determined how many from each group were found in the current edition of *Who's Who*, or, in the case of the oldest and the youngest students, were judged to be of equivalent rank. It was found that 50 per cent. of the "honour" men, 31 per cent. of the Phi Beta Kappa and only 9 per cent. of the remainder were entitled to this distinction.

At Harvard similar studies were made of students passing through the professional schools of Law and Medicine. The investigator concluded "the men who are destined to take the highest rank in the Law

* Nicholson, F. W.—Success in College and in After-Life. *School and Society*, August 14, 1915.

and Medical schools are markedly better scholars than their fellows both in preparatory school and in college. In intellectual power as in other things the boy is father to the man."*

The same conclusion is obtained by studies of after careers in industry. Dr. Rice† compared the grades achieved by students in the course in mechanical and electrical engineering at the Pratt Institute with the salaries received in after-life. The correlations varied from .16 to .46 and averaged about .27. The average salary of the topmost quarter was $1664, that of the bottom quarter $1279. The salary of the poorest group was thus only three-quarters of the salary of the best group.

All these investigations point consistently to one conclusion. " Those who are destined to achieve distinction and success begin to do so at an early age. Whether measured by achievement in academic courses, honours in professional and technical courses, salary earned after graduation, or inclusion among lists and directories of eminent men, success in later life is suggested by success in the early work of the school curriculum."‡

For a complete and perfect survey we should require standard measurements of ability and character, experimentally discovered, for every form of task in every form of industry; we should test the ability and observe the character of every young person about

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* Powell, A. L.—College Studies in the Professional School, *Harvard Graduates' Magazine*, Dec. 1910. *Educational Review*, Oct. 1911.

† An unpublished study quoted by Hollingworth, *op. cit. sup.* pp. 195-198.

‡ Hollingworth, *loc. sit.*

to choose his occupation. And upon a comparison of his performances with the standard requirements our vocational recommendations would be based. Such a scheme is but a remote ideal. In the present state of knowledge and the present condition of industry it lies far from actual realisation. But even an unrealisable ideal may prove, in formulating plans and elucidating proposals, an inspiring and suggestive guide.

For the immediate future, perhaps the most practical tasks for the psychologist to attempt are these: first, to urge certain firms to apply existing tests of intelligence and ability to employees of various grades; and, secondly, to urge certain schools to compile, during the long period for which each child is under observation and training, a *dossier* of mental and moral characteristics, a "personal file" which shall follow him from class to class, from school to school, and from school to industry. Such experiments would prove of immediate service to the individual cases handled; and demonstrate beyond all controversy the feasibility and the value of a more extended scheme.

On the profounder benefits to the nation as a whole this is hardly the place to enlarge. How much futility and unrest are saved by a congenial life-work! Everyone who has worked among the derelicts of society can testify how prominent a part is played by vocational maladjustment in human ruin—in the production of misery, of crime, of alcoholism, and of mental breakdown. Take two actual instances from one single firm. Here is a man fitted only for routine work; the worries of a responsible position have plunged him into neurasthenia. There stands another who would,

in a responsible position, have been entirely at home; the monotony of routine work has driven him to drink. The one was a round peg, the other a square peg; each was forced into the other peg's hole. Had their posts been interchanged, two serviceable careers would have been rescued; and the firm and the community alike would have gained.

Scientific guidance in the choice of vocation is thus something more than a proposition that will pay. It is a measure of social justice. Its first aim is to make for economic efficiency, to eliminate the gravest of all forms of waste—the waste of human material. But it claims a second and higher purpose—to satisfy the natural aspirations of every member of the community, to harmonise the life-work of each with his own inborn mental tendencies, and thus to reduce industrial discord, and alleviate social discontent.

LECTURE VI.

The Psychology of Advertising

By S. WYATT, M.Sc., M.Ed.

IN recent years advertising has developed by leaps and bounds. One has only to compare the number of advertisements in a current number of a popular or industrial magazine with the number which appeared in similar journals ten or twenty years ago, to form an idea of the extent of the growth.

In the past, advertising has been largely dependent on the "hit or miss" method. Sometimes an advertisement has been extremely successful because it has contained a device which has attracted the public attention and created a favourable and responsive attitude towards a particular appeal. On the other hand, a large number of advertisements are often so much waste paper, they fail to evoke a response and are usually completely ignored. In the United States it has been computed that 75% of the effort and expense expended on advertising is unprofitable, and in England the percentage of waste is probably much higher. Waste is a necessary accompaniment of all new departures and adventures; it becomes unjustifiable

and indefensible when it can be avoided by the utilization of scientific facts and laws.

Advertising is essentially an appeal to human thought, feeling and action, and consequently is subject to the laws which govern human behaviour. Since it is the function of experimental psychology to determine these laws, it follows that advertising, if it is to be effective, must take note of the discoveries in this comparatively new scientific field. Everyone is agreed, for instance, that one of the aims of advertising is to attract attention. It therefore becomes necessary for the advertiser to study the nature and laws of attention in order that he may embody this necessary knowledge in his appeals. A similar remark applies to other aspects of advertising, and the most successful advertiser will be the one who is familiar with psychological facts and who applies them to his work. It is often said that there are successful advertisers who are entirely ignorant of psychology and its teachings. This is perfectly true, but there are an infinitely larger number who are either failures or only partially successful because of their ignorance in this respect. One might as well attempt to become a first class medical practitioner without a knowledge of physiology and anatomy as strive to reach the expert stage in advertising without a knowledge of the mind and how it behaves in different situations. How many advertisers know exactly the relative value of a quarter, half, and full-page advertisement, or the suggestibility of lines and shapes of different kinds? Such problems lie on the very fringe of the subject and can only be solved by investigation and experiment. If advertising is to be really effective and economical, facts such as these

must be taken into consideration; yet in current advertising their application seems to be the exception rather than the rule.

Many firms, by determining the number of inquiries or the extent of the sales following an advertising campaign, do attempt to ascertain the effect of different advertisements, and much valuable information has been collected by this method. Such a process, however, is very costly, since the information is obtained after the advertisements have been devised, printed and published, and the campaign includes the numerous failures as well as the few successes. It is rather like building a concrete ship without taking into consideration the laws which will enable it to float. In addition, the data so obtained are very unreliable because the intrinsic value of the advertisement is not the only factor which evokes an inquiry or a sale. If advertisements were tested before being printed in large numbers and launched upon the public, the failures could be weeded out and a considerable saving in time and expense effected. In some cases this has been done under laboratory conditions, and the results obtained have closely resembled the later business returns. Even this method is far from being efficient, in so far as it is necessary to construct several advertisements before they can be tested. A much better and more scientific process is to study the laws which control human behaviour and embody these facts in the construction of the advertisement. A similar method prevails in other professions. Thus the physician applies the discoveries of medical science, and the aviator the laws of physics and meteorology. The advertiser is equally dependent upon the science

of psychology and will only approach the expert stage when he studies and applies the laws of this science.

In the past many advertisements have been partially successful because of lack of competition. In many cases they have remained unchallenged for years, but now that advertising has assumed such large dimensions they no longer monopolize the public eye. As Scott in America appropriately remarks, "When game was plentiful and marksmen few, anyone was successful in bagging game. When game is scarce and competition keen, he is successful who understands the habits of the game." Every day it becomes more and more necessary for every part of an advertisement to be worth its place, and the advertiser who succeeds will be the one who is acquainted with the laws of stimulus and response, and who applies these laws most effectively and efficiently in his advertisements.

It is the function of many advertisements to make known the existence of the goods advertised and to impress the public with their superior qualities, so that when the need for such commodities arises, only the particular make or class of goods advertised enters the mind. For instance, I may have been in the habit of using an ordinary razor, but I suddenly feel that I should like to try one of the safety kind. If the "Gillette" advertisements have fulfilled their purpose they will have impressed me to such an extent with their desirable qualities that when I enter the shop I ask for this particular make. In other words, the expression "safety razor" must immediately suggest "Gillette" and not another make.

Advertising is particularly necessary when a new and unfamiliar article is to be placed on the market. Most

individuals are very conservative in their habits and resent innovations. What has been good enough for their parents is usually good enough for them, and considerable force, in the form of an intensive advertising campaign, must be exerted before they are moved from the beaten track. In such a case the special qualities of the article must be strongly emphasized, and its advantages thrown into relief. Thus when safety razors were first introduced, their value to a man with an unsteady hand, the comfort of shaving, and the clean result, received special attention. The difficulty is to set the ball rolling, but once started, it "gathers as it rolls." Various devices are sometimes adopted to acquire the initial momentum. Occasionally an article is sent on approval with a request that it may be returned if found unsatisfactory. Frequently a sample is sent by post accompanied by a circular letter or demonstrations are arranged in various centres for the same purpose. The methods differ according to the nature of the commodity it is desired to sell, but they are all arranged with the idea of overcoming individual inertia and persuading the person to give the commodity a trial. Once the commodity is launched and has acquired the necessary momentum the advertising campaign may be slightly relaxed but must not cease. The object must still be propelled along its course, in the same way that power is still required to drive machinery even after it has started to move.

An attempt to introduce a rival commodity is confronted with a different situation. The public have already been made familiar with the nature and advantages of a similar article and have probably been

persuaded to use it in increasing quantity. Thus the rival article is able to benefit by this breaking down of public resistance, and the problem is how to divert the attitude of those who have been favourably impressed by the appearance of the first commodity to the side of the rival, and at the same time to extend the field to those who have not yet responded to the initial appeal. It is analogous to changing the direction of a stream which is already flowing strongly in a well-worn bed. This diversion is usually accomplished by an advertising campaign which emphasises the peculiar features of the rival article without at the same time pointing out the weakness of the commodity which was first in the field. If the latter method is adopted it only serves to draw attention to the rival, when the object is to fill the mind with the name and qualities of the newer article.

Many advertisers fail to recognise the difference between an advertisement which appeals to a general desire to behave or act in a certain way and one which suggests a particular response to a general situation. Thus many advertisements for motor cars depict the joys and comforts of motoring by means of picturesque and attractive scenes which usually include one of their cars passing through the district. The chief effect of such an advertisement is to create a desire to own a car but not necessarily the particular car advertised. In this way the makers of all kinds of cars benefit at the expense of one firm, and it would be interesting to know how far some firms have profited by the advertisements of others. Probably a much more effective and economical advertisement would be one which emphasises the particular selling

features of a car, or, if a picturesque scene is to be included, the additional comfort and luxury obtained by using a certain make of car should receive particular attention.

These few preliminary remarks will probably illustrate some of the problems which confront the advertiser, and the following account will be devoted to a description of the methods and devices which may be used in solving these problems.

Attracting the Attention.

The first, but by no means the only test of a good advertisement is the ability to attract the attention. Obviously unless one attends to an advertisement, even if it is only on the fringe of consciousness, it fails to make an impression and to be remembered. At this stage it may be advisable to enumerate some of the more important characteristics of attention and to discuss their application to advertising.

Attention has often been described as a state of consciousness exhibiting a focus and a margin. For instance, when looking at the window of a tobacconist's shop, we may focus our attention at any particular moment on a certain box of cigars near the centre of the display, but at the same time we are vaguely aware of the existence of other cigars, cigarettes, and tobacco in other parts of the window. We may also be faintly conscious of noises in the street, of people passing by, and the uncomfortable heat of the sun. With the exception of the one box of cigars, all the other objects are in the margin of consciousness, and usually fail to make a lasting impression on the mind.

When rays of light pass through a converging lens, they are focussed on one particular point, which stands out in relief from its surroundings. In the same way the process of attention causes consciousness to be concentrated on one particular object, and enables it to be perceived clearly and with ease. The mass of form and colour which is to be found on our large advertising boards is usually only noticed "out of the corner of the eye" until one particular part of it catches the attention, when that part at once becomes clear and distinct while the remaining posters still form part of the dim background. All the posters on the boards are mutely pleading to be noticed, but the passer by merely bestows a momentary glance upon them. The aim of the advertiser is to create a poster which will stand out above its rivals and compel attention. This end may be achieved with the assistance of various devices which may conveniently be called mechanical and interest incentives.

Mechanical Incentives.

One of the commonest examples of a mechanical incentive is intensity. Other things being equal, we usually attend to the strongest or most intense stimulus. Thus the brightest star is often the first to attract the attention. In the field of advertising, the application of this factor of intensity is to be found in the construction of electric signs and bright posters, but its use is very limited. One cannot continue to increase the intensity of a light or sound indefinitely; after a certain time a limit must necessarily be reached, unless a new method is devised. Intensity by itself

is of little value; it may succeed in momentarily attracting the attention, but it cannot hold it.

A device which is more frequently employed in attracting attention is that of magnitude or size. A large object usually catches the eye, and this property is often employed in advertising. If a number of aeroplanes are seen in the sky, the one which appears to be the biggest will be the first to be observed. Advertisers who spread their advertisements over the side of a house or a bridge make use of the attention value of magnitude, and such advertisements are almost certain to be noticed by people within a certain area. A much more important aspect of magnitude is to be found in the question of the relative value of the quarter, half, and full-page advertisements in journals and magazines. Has a full-page twice the value of a half and four times the value of a quarter page? The answer to this question is of considerable importance to advertisers from both a business and a financial standpoint. Several investigations have been carried out with a view to solving this problem, and it has been found that the value of an advertisement is not directly proportionate to its size, but increases approximately as the square root of the area. Thus, if the value of a quarter-page is represented by 1.00, then the value of a half-page is 1.46 and that of a full-page 2.20. According to these results it appears that it is much more economical to have four quarter-page advertisements than one full-page, and similarly two half-pages are better than one full-page. At the same time, a full-page advertisement has many advantages over the half and still more over the quarter page. In the first place it has no rivals on that page and

consequently if only a glance is bestowed upon it the advertisement must benefit to that extent. Further, a large advertisement enables illustrations to be used which are impossible in one of smaller size, and it also suggests a certain amount of prestige and prosperity, since persons who are able to do things on a big scale become associated with wealth and success. Many other aids to attention, such as isolation and contrast, can be used with advantage in an advertisement of large size. Like intensity, magnitude alone is only one of the minor devices which are used in attracting attention.

Movement is another device which is sometimes employed in attracting notice. Everyone is familiar with the involuntary way in which he looks at a shooting star, when the myriads of other stars remain unobserved. Similarly a rabbit is much more easily perceived when it begins to move than when it is stationary. In the same way we are attracted by moving objects in a shop window, or by signs which change. As an initial attractive force movement is very powerful, but afterwards its effect rapidly decreases.

Another mechanical aid which frequently arouses attention is contrast. It is well known that differences are more easily noticed than similarities, and consequently lead to exaggerated and unwarranted beliefs. Examples of the effects of contrast are both numerous and varied. The slow transition from day to night passes unnoticed but the plunge of a train into a tunnel is perceived by all. Colour contrasts are often employed in advertising with considerable effect. Blue on yellow, or red on green are very effective contrasts, and it is interesting to know that

black on white attracts attention more readily than white on black. Isolation is really a special form of contrast, and usually means absence of counter attractions in the form of other objects. Frequently it enables the advertiser to monopolize the whole space, and consequently to exclude all rivals. Like all other forms of mechanical incentives, it has little value unless reinforced by interest appeals.

The position of an advertisement on a page or in a magazine is an important factor in advertising. Starch in America found the value of the upper half of a page to be 61% while the value for the lower half was only 39%. When the page was divided into four equal parts, the memory value of the right hand upper quarter was found to be 33%, the left hand upper quarter was 28%, the right hand lower quarter was 23%, and the left hand lower quarter 16%. Thus the psychological value of the right hand upper quarter is more than twice that of the left hand lower quarter, yet this fact is seldom taken into account by advertisers. Still greater differences are to be found in connection with the position of a page in a magazine or journal. As a general rule the beginning and the end are more frequently observed than the intermediate positions. An investigation on this question has been carried out by Strong in America, the results of which showed that the pages preceding and following the reading matter, together with the cover pages, had much greater attention value than the remainder. Hollingworth also found that the value of the front advertising section was about 50% better than that of the back section. Facts such as these are of considerable importance to advertisers, and their proper

utilisation may make a vast difference in the efficiency and economy of an advertising campaign. At the same time, mechanical incentives have a very limited value and application, and may only succeed in momentarily attracting the attention.

Interest Incentives.

The advertisements which appeal to individual interests and instinctive tendencies are much more important and valuable. Instincts are deep seated tendencies common to all races and peoples and consequently advertisements which appeal to these inherited tendencies to act along certain lines are liable to arouse interest and evoke response wherever they are seen. The fashion plates in many of our journals appeal to the instinct of self-display. The healthy appearance and attractive smile of the Virol babies utilise the maternal instinct very effectively. Antique dealers owe much of their success to the existence of the collecting instinct, while Pelmanism makes considerable use of the instinct of self assertion. Such instances are typical of many, and an exhaustive study of the instinctive basis of advertising would occupy many volumes. It is sufficient to note that instincts are some of the most powerful springs of action, and are currents on which advertisers would do well to float. Very similar to instincts, and in fact often grafted upon them, are acquired interests and habits. They are probably not quite so widespread or deep-seated but they form valuable points of contact for the advertiser. Common illustrations of such habits are smoking or drinking before or after meals,

and the cool and soothing qualities of certain tobaccos or the appetising and recuperative effects of certain drinks are avenues of appeal frequently employed. Habits are the rails which direct our passage through life and enable us to move along with a minimum of effort, and advertisements are the signposts urging us to accelerate our speed or to change our direction. The effort required to divert us from our course is proportional to our momentum, and this in turn is dependent in part upon the propelling force of our instinctive tendencies and acquired habits. It is accordingly easier to move along the path of interest and habit, and to frame advertisements with this end in view.

In addition to the broad instinctive basis of appeal, we find that peoples of all races are attracted by suitable colour combinations and contrasts. The influence of different colours upon different people constitutes a most interesting study, but it is sufficient to point out here a few of the more obvious effects. The red end of the spectrum suggests warmth and is frequently stimulating; in fact, on some occasions it is decidedly irritating. On the other hand, blue is a comparatively cold colour, and is suggestive of the passive state. It is also a well known fact that our preference for certain colours changes at different periods of our lives. As a rule, children prefer the brighter colours, such as yellow and orange, while educated people prefer yellows and blues. A pleasing colour scheme invariably attracts the attention, and can be used with great effect in advertising. If we look at a catalogue or book containing a few coloured and several black and white illustrations, the former almost

always occupy the greater part of our attention, and are more easily remembered. Experiments in Chicago have shown that a cut in colour often sells fifteen times as well as a plain black and white cut of the same article. Although coloured cuts involve additional expense, it is probable that the extra outlay is more than repaid by the increased sales. Most of the present day catalogues fail to make use of this fact; but some beautiful illustrations in colour are to be found in the Chamber of Commerce publications for different towns. Colour also enables the texture, pattern, or hue of an article to be represented with greater accuracy and vividness, and conveys a much more precise idea of the actual shade. The word "green" may include innumerable shades between yellow and blue, but the exact shade can be represented by means of colour. Our perception of the third dimension, or depth, is inadequately represented by scenes in black and white, but is much enhanced by means of colour. Thus a greenish blue hill suggests a moderate distance, but one of greyish blue appears to be much more remote.

Another factor which usually succeeds in attracting the attention is novelty, but there is always a danger that attention will be directed to the novel feature of the situation and not to its underlying purpose. The appearance of a stage-coach carrying some of Dickens' most famous characters in the streets of London undoubtedly attracted attention and may have induced people to take part in the celebrations. Similarly an announcement that we spend about 2,900 hours in bed each year is an unusual way of representing this common experience, and may make people consider

the advisability of securing a more comfortable bed since such a considerable portion of one's life is spent in contact with this necessary feature of every home. Advertisements which represent situations viewed from an unusual angle are usually very effective, and yet they are by no means common.

Closely related to the novel is the comic. Advertisements by Hassall are good examples of humorous appeals, and they seldom fail to evoke interest and amusement. Here again there is always the possibility that the humorous situation will be perceived but not necessarily the article advertised. The danger is readily illustrated by showing a number of humorous advertisements to different people and afterwards asking them to name the goods advertised. In many cases they are quite unable to do so. Another objection to advertisements of this kind is that they often lose their interest when once the humour has been fully perceived. Hollingworth, however, has shown that the rapidity with which the interest fades depends upon the kind of humour depicted. If the source of amusement is objective, as, for example, in many of Hassall's drawings, interest is maintained over a considerable period, and may even increase with time. If, however, the humour is subjective, as is illustrated in the case of puns and wit of different varieties, interest often disappears rather quickly and may give place to boredom.

Holding the Attention.

It is a matter of common experience that many things attract but fail to hold the attention; in fact

the process of attracting the attention is merely the first stage in the advertising campaign. A momentary glance at an advertisement usually makes only the faintest impression on the observer, and the effects are probably quickly forgotten. In order that an advertisement may hold the attention, it must possess features which successively attract the attention, preferably one predominant element and several of a secondary nature. The mind cannot remain concentrated upon one feature for long, but usually moves fairly rapidly from point to point. It is therefore advisable for the advertisement to possess easy paths of transition which occasionally lead back to the primary element. This is often accomplished by means of suitable lines or arrows which suggest the route to be taken. Another important aspect of an advertisement is the feeling it arouses when perceived. We are not merely aware that the advertisement exists, but experience a feeling of pleasure or displeasure which varies in intensity according to the nature of the display. Thus a group of biscuits or fruit daintily arranged may be distinctly pleasing, but an advertisement for tooth paste which utilises negroes may be most objectionable to some people. As a rule, we tend to continue or prolong processes which give us pleasure and to avoid those which are unpleasant. The application of this rule to advertising is responsible for the success of many advertisements and is an important factor in holding the attention, since impressions which give pleasure tend to persist in consciousness.

The feeling tone of an advertisement is dependent upon the content and form of the display. Usually an attractive arrangement of colours is sufficient to

arouse a pleasant feeling, but more frequently the nature of the images revived by the advertisement decides the nature of the accompanying feeling. Thus images of taste often arise from a perception of displays of foods, or reminiscences of holidays are revived by representations of places visited. Even the name of a commodity may appear pleasing or disagreeable and have a considerable effect on the tendency to purchase that article. The evil effects of this general tendency is seen in many advertisements which give rise to exceedingly unpleasant associations. Frequently tramps are associated with soaps and lotions, or an influenza cure may be placed next to a memorial notice. Conversely, some advertisements shine in a borrowed light, and a firm which has achieved a reputation for a certain article may find a big demand for a different commodity which they later put on the market. The quality and reputation of a periodical or paper have a similar effect.

The effect of the form of the advertisement is seen in the nature and direction of the lines and the shapes employed in its construction. Even the simplest line possesses meaning and gives rise to a certain amount of feeling. Thus a fine, grey line suggests delicacy of texture and might be used with advantage in advertisements for silk fabrics and jewellery.

Fixing the Impression.

When the attention has been attracted and held, the next process is to fix the impression, so that when the need for a certain commodity arises, the name will immediately enter consciousness. One of the

most usual ways of causing the impression to be retained is by repetition. In this respect the process is somewhat analogous to a stream which in the course of time wears out a deep bed. It is interesting to note that Adams in America found that variation in a part of the advertisement when frequently repeated, as in the weekly or monthly issues of a periodical, is about twice as effective as mere repetition of the same advertisement in these successive numbers. At the same time, mere repetition, unless accompanied by interest and attention, is very ineffective.

In connection with the question of fixing the impression, the results obtained from experiments on the rate of forgetting may be instructive. It has been shown that after material has been memorised, the rate of forgetting is rapid at first but proceeds more slowly afterwards. In order therefore to neutralize the effects of this law, Hollingworth suggests that the appeals should not appear at regular intervals of, for example, a week, but should occur most frequently at the beginning of the campaign, followed by successively increasing intervals. Thus the second appeal may follow two days after the first, the third five days later, the fourth after an interval of another ten days, and the fifth twenty days after the fourth.

Retention is also assisted by emotional associations. An experience which evokes a similar emotional experience to a previous event is likely to be associated with it and to be remembered with ease.

The "return coupon" which forms a part of many advertisements also tends to facilitate retention and recall. The impression received is strongly reinforced by the act of writing and sending the coupon; in fact

the impression-expression circuit is completed by this means. In addition, the " return coupon " enables the reader to reply to the advertisement along the lines of least resistance. It is much easier to fill in the blanks than to compose a letter, and many people have difficulty in deciding upon the correct mode of address at the beginning and end of a letter. The effort of composition and the possibility of revealing ignorance are serious obstacles to a reply.

In some cases unnecessary difficulties are encountered because the coupon is placed in a position adjoining the inner edge of the page with the result that much cutting or tearing is necessary before it can be sent.

It has also been established that an idea tends to revive an association which has followed it in the past rather than one which has preceded it; thus " S " suggests " T " rather than " R " and " 5 " is followed by " 6 " and not " 4." In advertisements it is advisable to place the general class first followed by the name of the special article in this class. For instance, the upper part of a poster might contain the remark " When feeling depressed " and be followed by the advice " Take Smith's Tonic," but not the reverse order. Since in the past the advertisement has been read in this order, when the feeling of depression occurs, the particular remedy will probably be recalled.

In connection with the problem of conveying a clear and accurate impression, illustrations play a very important part. Often a mere verbal description of the article leaves us cold and unresponsive because it fails to convey a definite idea or lead to a true appreciation of the commodity described. For instance an illustration of an office containing a suitable arrange-

ment of furniture may create a desire to furnish our office in a similar manner, but a descriptive statement of the articles would leave us unmoved. The construction of a scene in imagery which is different from anything previously experienced is a feat of constructive imagination, and usually involves a considerable amount of effort. Many people are not equal to such a task and prefer to reproduce a scheme which has been devised and illustrated by others. It is much easier to imitate than to create.

Various other minor devices are used to fix the impression, particularly rhyme and alliteration or various forms of ingenuity. The expression " Fight the 'Flu with Formamint " is easily remembered and " Uneeda Biscuit " or " Keen Kutter " are retained without effort.

Evoking the Response.

The ultimate value of an advertisement depends upon its ability to persuade the public to act in the manner suggested by the advertisement, and one of the most powerful aids to action is suggestion. In general, it is never advisable to suggest interference in the form of a rival idea or opposing action, but to concentrate attention upon the particular commodity it is desired to sell. It is also widely realised but not always applied in practice that the strength of a suggestion is increased by the belief that the idea originates within oneself. Many people resent advice to behave or act in a specific manner, and like to think that they themselves are responsible for their behaviour. It is therefore frequently necessary to disguise the source

of the suggestion by embodying it in news of an interesting nature. Often the same result can be obtained by constant use of repetition and variation, so that the time and place of origin of the suggestion either becomes indistinct or completely lost.

The power of the source of the suggestion is of great importance and is used frequently in advertisements which depict eminent men using a particular article or praising its qualities. Individuals usually imitate those whom they admire, consequently the fact that a well-known man uses a certain commodity or follows a certain course is sufficient to induce the reader to act in a similar manner.

Frequently the repeated suggestion that a commodity possesses certain qualities leads to an absolute belief that these desirable features actually exist even in an exaggerated form. Thus constant reiteration of the purity and delicacy of a soap combined with illustrations of refined ladies with delicate skins using this soap creates a belief that the soap does actually possess the qualities described even though it may be an inferior article.

The reputation and nature of a journal in which the goods are advertised and the manner in which they are placed before the public have a strong suggestive influence. In this connection many firms have found it profitable to use reproductions of famous pictures in their advertising campaigns since the quality and reputation of the picture sheds a similar radiance over the goods advertised. In the same way borders suggest an atmosphere which may influence considerably the impression made by the advertisement. For instance, the general effect of an advertisement for

oriental carpets is enhanced by a border of mosques and turrets or ancient signs and symbols.

Frequently the emotional colouring of an advertisement is very suggestive and tends to give rise to a similar emotional echo in the individual. Everyone is familiar with the suggestibility of a smile and it is probable that the expression of the underlying emotion revives a shadowy form of the actual emotion. Thus a suitable advertisement may evoke a decidedly pleasant attitude and create a favourable impression. Variations of this principle could be widely applied in advertising, but at the present time it seems to be sadly neglected.

It is hoped that this brief enumeration of some of the psychological factors involved in advertising will indicate a few of the many interesting problems which exist in this comparatively unexplored field; and suggest other questions for investigation and research.

LECTURE VII.

Social Psychology and the Industrial System

By T. H. PEAR, M.A.

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INTRODUCTORY.

IT is difficult to condense into one short chapter the contents of four lectures which were themselves but a summary of lengthy psychological writings. One fears that the attempt to compress what is already a tabloid must inevitably destroy any little palatibility which it may have possessed. The terminology of modern psychology is not yet familiar enough to the general reader for an exposition without examples to make easy reading. The admitted inadequacy of this account may be lessened slightly if the reader will refer to the fuller report of these lectures.*

In them it was pointed out first, that the late 19th and early 20th centuries have brought about a widening of the psychologist's mental horizon comparable with the newer way of regarding the sea which recent events

* *Engineering and Industrial Management*, Sept. 25th, 1919, *et seq.*

have forced upon the navies of the world. A century ago the sea, for the naval student, meant its surface: even the derivation of the term "submarine" testifies to this. At the same time the mind, for many psychologists, meant *its* surface; exhibiting cross-currents, shoals and eddies the direction of which was more or less clearly indicated by the course of those relatively robust surface-craft, the perceptions, images and thoughts, which sometimes fulfilled their functions properly, but just as often lost their bearings, wandered into the wrong harbours, or became mysteriously wrecked. No longer may the student of naval affairs ignore the possibilities of attack from below the surface of the ocean, no longer can the psychologist be content to recognise merely the surface-craft, those phenomena of which he is clearly aware; to give to the world, as one acid critic has said, an account of "how he thinks he thinks." He is compelled to consider motive forces and driving powers which lie below the surface of the mind, forces which though they occasionally upheave consciousness and split it asunder, are nevertheless, in a less dramatic fashion, continually affecting its quality and direction. And these rendings of the personality, the study of which has compelled psychologists to recognise the power of unconscious processes, have an obvious counterpart in the forces which split the body politic.

Simple minds sometimes ask "What is *the cause* of the present industrial unrest?" To them it may be answered that of its numerous causes some are relatively easy to trace because they are currents which are visible on the surface. But probably some of the most potent factors have their roots in causes

which are almost or quite inaccessible to superficial analysis; in customs, conventions, beliefs and emotional attitudes the roots of which lie in the far past. A common view of belief is that the person holding it is consciously aware of the historical reasons for that belief. The demonstration that this is frequently untrue is of great importance in the present connection.

THE CONCEPT OF "BEHAVIOUR."

To delimit the boundaries of the territory which the psychologist may explore is an interesting task for the theorist, but need not delay us here. We may accept, as a policy, Mr. McDougall's view of psychology as the *positive science of the behaviour of living things*, not forgetting the deep significance of the adjective "positive." Psychology studies the facts of behaviour as they are; to other sciences of behaviour it leaves the task of setting up standards—of good and evil, correct and incorrect, beautiful and ugly, by which those facts may be judged. And it is just because we are human that it is so uncommonly difficult to adopt such a detached positive attitude towards behaviour, whether it be our own or the other man's. Not a few analyses of social behaviour, beginning well as psychology, have developed into hortatory essays upon popular ethics, while the end of some has been in the manner of an encyclical.

What meaning may properly be attached to the word "behaviour"? It may be simply described as adjustment to environment. But it must never be forgotten that for man, the environment which nowadays may trouble him least is the physical, while his social

surroundings may offer him endless and eternally changing difficulties. To his physical environment he has been superlatively clever in adjusting himself, (one wonders sometimes whether "advancement of science" means to many minds anything more than the invention of devices for avoiding heat, cold, rain, and hunger, many of which avoidances have been paid for by increased susceptibility to disease); to his social environment, for which his own species is responsible, adjustment appears to grow more difficult every day. Man's influence over inanimate nature has now become so great that our palate has become somewhat jaded by accounts of its progress. There are children who no longer look up when an aeroplane appears: there are adults who feel no joyful thrill at the possibility of transatlantic telephony. Parallel with this success in understanding dead matter we see very little desire to comprehend human forces, the interaction of which daily becomes more complex and threatening. Such attempts have been made, however, and it is in the attempt to give some slight idea of the direction and success of these efforts that this summary is being written.

Different Kinds of Behaviour.

Man's adjustment to his environment falls into different categories. It may be immediate, as when his eyelid falls instantaneously to protect his eye from a threatened blow, or deferred, as when he waits at the railway station for a train. His present adjustment may be to the essential details of a situation immediately present, as when he hits back on being

attacked, or to an extraordinarily remote one, as when he pays money to an insurance company to provide for the university education at eighteen, of a week-old baby. It is just the difference in the ways in which these various kinds of adjustment are effected, and their relative frequency, which marks off the lower from the higher animals, the child from the man, the simple from the complex mind.

It is clear that the examples given above demonstrate the action in different degrees of the two chief factors which bring about these differences in behaviour, heredity and environment. The protective blink-reflex is subserved by an inborn bodily mechanism, its action occurring without any necessity for previous experience. The purchase of an endowment policy, on the other hand, cannot be referred so confidently to the activity of a pre-existent nervous mechanism: it is *par excellence* an example of an individually learned action. Yet probably we shall not go far astray if we suspect the presence at the bottom of even this highly modern adjustment, of an organised nervous structure:—that subserving the emotion of fear. For it is certain that fear underlies man's so-called intelligent caution. It provides the motive power while intelligence is responsible for the steering-wheel and the brakes.

The Influence upon Behaviour of Inborn and Acquired Factors.

It is now necessary to distinguish carefully between behaviour, the character of which depends upon inborn bodily connections—of sense-organs, nervous system,

and locomotor apparatus—and that which can be referred to connections which have been acquired during the lifetime of an individual. Of the first type, the simple response to an external stimulus which is known as a *reflex action* is an excellent illustration. Such an action may be entirely carried out by the mediation of the spinal cord, the influence of the brain being unnecessary. The hind foot of a frog whose brain has been destroyed will be lifted in an "attempt" to remove the source of irritation, if a drop of weak acid be applied to the skin of the animal's trunk.

In such a reaction, whether in the simpler animals or in ourselves, the entire nervous mechanism which executes it is inborn. The reaction may be suppressed or altered later, under the guidance of experience, but it remains a performance to the integrity of which the co-operation of the brain is not essential.

INSTINCT.

We pass from this type to another in which the behaviour of the animal, though infinitely more complex, apparently still depends entirely upon inherited structures. This class is that of the *instincts*.

In the fuller report of these lectures some account has been given of the developments through which the psychological view of instinct has passed during the last century. Little can be said here except that the older view that the lower animals are distinguished mentally from man in that they are guided exclusively by Instinct, while he is led equally exclusively by Reason, is held by nobody who has studied the

behaviour of these organisms. The universal acceptance by the scientific mind of the doctrine of evolution has made such an attitude impossible. Yet it is clear that in many ways the behaviour of man is decidedly more complex (one hesitates to use the word "higher" except in this very sense of "more complex") than that of the highest animal below him in the scale. The probable reason for this will be more easily understood when this exposition of instinct has progressed a little farther.

For scientific purposes the meaning of the word "instinct" is much narrower than that which it bears in everyday life. We may turn to two modern definitions which supplement each other :—

> We may define an instinct as an inherited or innaet psycho-physical disposition which determines its possessor to perceive, and to pay attention to, objects of a certain class, to experience an emotional excitement of a particular quality upon perceiving such an object, and to act in regard to it in a particular manner, or, at least, to experience an impulse to such action.[1]
>
> Instinctive behaviour comprises those complex groups of co-ordinated acts which, though they contribute to experience, are, on the first occurrence, not determined by individual experience, which are adaptive and tend to the well-being of the individual and the preservation of the race; which are due to the co-operation of external and internal stimuli; which are similarly performed by all members of the same more or less restricted group of animals; but which are subject to variation and to subsequent modification under the guidance of individual experience.[2]

Striking examples of instinct may be quoted from McDougall :—

> The solitary wasp laboriously drags to her carefully

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1 W. McDougall, *An Introduction to Social Psychology*, p. 29.

2 C. Lloyd Morgan, on "Instinct," *Encyclopaedia Britannica*, (11th Ed.), Vol. xiv., p. 648.

prepared nest the prey secured by a day's hunting, and seals it up there together with her egg, in order that it may serve as food for the offspring which she will never see, and of whose needs and existence she can have no knowledge. The young bird flies a thousand miles across land and sea, seeking, she knows not why, the climate best suited to her young. She builds her nest according to the pattern of the species and broods over her eggs; experiencing, we may suppose, a continued satisfaction in the progress of her work; but without, we may confidently say, once thinking of the young birds to whose welfare all her labours are directed.[1]

Of the two definitions quoted above Ordway Tead writes[2] :—

The essential points in these definitions are almost identical. They both agree that the individual is born with certain fairly pronounced dispositions or tendencies. These tendencies are variable, they are adaptive, they are held in check by the desire for preservation. In other words, the biological economy, instead of requiring each organism to learn anew the whole wide range of experience which is safe and has existential value (to borrow James's phrase) endows each organism with a strongly compelling urge to activities which contribute to survival.

This adaptive function of the instinct appears clearly as a provision of nature which excuses the individual organism from learning by personal experience all those possible characteristics of all probable situations which may mean for it danger or advantage. In the age-long struggle of the species for existence the instincts have been hammered out, so to speak, by the pressure of circumstances. The animal which possessed the best inborn nervous mechanism for dealing with its difficulties survived and perpetuated its species with another, somewhat similar survivor; the unfortunate in whom the ready-made structure

1 *Psychology*, Home University Series, 1912, 149-150.
2 *Instincts in Industry*, London, 1919, 8.

was less efficient, perished, and his kind was less often reproduced.

Now in this provision of apparatus wherewith to meet the unforeseen, Nature seems to have tried two experiments, both of which—if one may say so with due respect—appear to have been fairly successful. Her two trial-grounds were in the regions of the invertebrates and the vertebrates respectively. The former, of which we may take the insects as a good example, appear to be endowed with almost perfect ready-made possibilities of adjustment to the somewhat limited classes of situations which normally require them. The instincts of the bee, familiar to most of us through the beautiful descriptions of Fabre and Maeterlinck, appear to be almost perfect in their capacity for adjusting their possessor to its environment. In fact, the apparent perfection is so great that most writers have described it as if it were complete; as if the key fitted the lock perfectly. More recent and exact observation makes it clear that even in the case of such insects there is always a little play of the key in the lock, always a suspicion of unpredictability about the performance if only it be observed carefully enough. Yet speaking crudely and broadly, we may say that the very perfection of the insects' instincts implies, on the other hand, a relative fixity, specificity, incapability of improvement by experience.

When we consider by contrast the case of the higher vertebrates, of which man is the most complex example, we are struck by the apparent imperfection of their instincts; so much so in the case of man himself that for centuries it was believed that he did not possess them.

Yet, as if set off against the obvious imperfection of man's adjustment to his environment by means of his instincts, are the generality, fluidity, plasticity of his reactions and their capacity of enormous modification and improvement, or degradation, in the light of experience. It is this latter improvement—and probably too this degradation—which is brought about through that factor which we call intelligence.

The reader may, however, now ask why, if the instincts of man have been evolved in order to meet the demands of his environment, their success at the present day should have been so partial, to put it mildly. To say merely at this point that intelligence is the force which normally guides behaviour, while instinct furnishes the motive power and a certain amount of the guidance, may sound supremely unsatisfactory. Yet that such an answer can be successfully maintained is the thesis of these lectures.

One of the chief reasons for the present-day lack of success of instinct in adjusting civilised man to his environment is the kaleidoscopic and (to borrow a current political description) "grasshopper" nature of his surroundings. Man's difficulties in adjusting himself to his social environment, to the demands of his fellows, are to-day often immeasurably greater than those arising in connection with his physical surroundings. The physical environment, too, differs from the social in that its demands upon man are usually quite unmistakably clear to him. The reactions appropriate to cold, to hunger, to the threat of wild animals more or less powerful than himself; all these are obvious to him. But his difficulty in choosing

between desire and duty may lie in not knowing exactly which duty is right. "To thine own self be true" is advice easy to follow by the fortunate person who can truly be said to have only one self. In other words, the social environment has this great disadvantage over the material, that it is often fickle, inconstant in its demands, fluid, unstable, unpredictable. And seldom or never in history has it merited all these adjectives so thoroughly as to-day. We cannot expect Instinct to keep pace with a protean environment. Nature's ways are the ways of centuries, not of years or months. By no process of natural selection can the race develop ready-made possibilities of adjustment which will suffice to fit the unstable pattern of our modern social surroundings.

Another consideration which helps us is due to the investigations of twentieth-century medical psychology. It is that an instinct when denied its normal satisfaction or repressed, does not cease to be, but may force an outlet by devious ways which actually do hinder the person's adaptation to his environment. In this way, according to the teachings of Freud and his followers, there arise nervous symptoms, hysteria, perversions, in fact, those mal-adaptations to environment which are so striking a feature both of the individual and of the community to-day.* To this matter we shall return later.

* . . . . "it is now all too plain that the undercurrents of industrial unrest and discontent which come to the surface with increasing frequency have had their source in an unconscious but tremendously effective repression of human aspiration and desire. The release of energy and vigour, which is needed to clear the air, will not come until we see human nature as it is." Ordway Tead, *op. cit.*, Preface, p. x.

Another very common difficulty is attributable to a frequent confusion between the action of a simple fundamental instinct, and tendencies to behaviour arising from more complex mental growths which will be discussed later under the name of sentiments. A striking example of this confusion has been shown by Perry[1], who distinguishes clearly the primitive instinct of pugnacity from that complex of instincts, sentiments, beliefs—rational or irrational—and ideals which shows itself in the tendency for one community to make organised warfare upon another.

Lastly, a great source of difficulty in understanding the present utility of instinct is provided by a number of tendencies (often included under the loose blanket-term "herd instinct") which appear to swamp or to cut across the direction of the other instincts. This modification of the other instincts which occurs in animals living in communities is so important that it will be discussed separately.[2]

INSTINCT AND EMOTION.

So far we have considered instinct merely to be an inborn capacity to *act* in a particular way when a stimulus of a certain kind is perceived. The description has been purely that of an external observer. Nothing has been said concerning the way in which instinct feels "from within" to the organism experiencing it.

An important feature of the conception of instinct

1 "War and Civilisation," *Bulletin of the John Rylands Library*, Manchester, 1918.

"An Ethnological Study of Warfare," *Proc. of Manchester Lit. & Phil. Soc.*, 1917, Vol. LXI, part II.

2 In the fuller report of these lectures, (see footnote to page 1)

propounded by McDougall is that instincts and emotions are not only indissolubly connected but that they are merely the outer and inner aspects of the same occurrence; that the actual experiencing of the instinctive " urge " is the emotion. It is impossible here to discuss the theoretical implications of this assertion, but it is a matter of common experience that a tendency to run away or to be paralysed in the face of danger is usually accompanied by fear, a tendency to strike out when insulted, by anger, a tendency to cherish the tiny, young and helpless, by tender emotion.

Upon the exact number of the instincts there is as yet no complete agreement, but fair agreement exists concerning the general nature of these inborn dispositions and the functions which they perform. A recent writer, Mr. Ordway Tead, from whose book "Instincts in Industry" we have already quoted, considers " the instincts whose functioning throws light upon human behaviour as it is revealed in industry " to be (1) the parental instinct, (2) the sex instinct, (3) the instinct of workmanship, (4) the instinct of acquisitiveness, (5) the instinct of self-assertion, (6) the instinct of self-abasement, (7) the herd instinct, (8) the instinct of pugnacity, (9) the play impulse, (10) the instinct of curiosity.* He continues :—

* See in this connection: William James, *Principles of Psychology*, vol. II, chap. xxiv; William McDougall, *Social Psychology*; Maurice Parmelee, *The Science of Human Behaviour*; Graham Wallas, *The Great Society*, chaps. i-x; William Trotter, *Instincts of the Herd in Peace and War*; Thorstein Veblen, *The Instinct of Workmanship*, especially the Introduction; Edward L. Thorndike, *The Original Nature of Man* (vol. I in *Educational Psychology*); Wesley C. Mitchell, "*Human Behaviour and Economics*," *Quarterly Journal of Economics*, November, 1915; C. G. Jung, *The Theory of Psycho-Analysis*; I. Metchnikoff, *The Nature of Man*. (Quoted from Tead, 10-11.)

Since we are less concerned with the constituent nature of these impulses than with the character of the behaviour to which they prompt, it is irrelevant to discuss whether certain of them are or are not reduced to their simplest terms. Scholars may decide that the impulse to workmanship is only a specific manifestation of the instinct of self-assertion, or that the herding tendency is a complex of the pugnacious, parental and some other instincts. Their decisions will affect only slightly the validity of the conclusions reached by such studies as this. My aim is to estimate the influences exerted in industry by widely acknowledged constituent elements of human nature, not to subject these elements to more refined analysis.[1]

Students of psychology will notice that, according to McDougall, in the above list, the tender emotion and the emotions of elation, subjection, anger and wonder correspond to the parental instinct and the instincts of self-assertion, self-abasement, pugnacity and curiosity respectively, while the other instincts have emotional accompaniments which are less well-defined.

IMITATION, SYMPATHY, SUGGESTION.

We have still to mention a universal inborn human tendency, the importance of which is almost overwhelming in modern society as it is constituted at present. This is the tendency to imitate, or to do as our fellows do, other aspects of which[2] are the tendency to sympathise, or to feel as others feel, and the tendency to be suggestible, or to think as others think. The wild-fire trail through a country of a perfectly useless fashion in dress, the lightning spread of emotion through a crowd, the amazing spectacle of educated people solemnly following in

1 *Op. cit.*, 11-12.
2 According to McDougall's *Social Psychology*, 96*f*.

the track of every unpredictable political caper of a popular news-sheet :—such illustrations of this tendency are familiar to everyone : for which of us is exempt from its sway ? Yet when we reflect that nearly all our important beliefs have been implanted in us by this very agency of suggestion, which forces us to accept a proposition with conviction in the absence of logical evidence for its truth, it will be seen that no understanding of the pros and cons of an industrial problem can be complete without an appreciation of the power of this factor.

Habit.

When, in an earlier part of this essay, the behaviour of the insects was compared with that of man, the fixity and relative perfection of their inborn tendencies towards adjustment were contrasted with the generality, imperfection and plasticity of his own. One might almost assert that if a bee could write an introspective account of its conduct, it would fail to distinguish between its instincts and its habits. For man such a distinction is easy. A human instinct is a general type of response to a general situation ; it is shared with other members of the same species, and its foundation is inborn. A habit, on the other hand, is usually a specific response to a specific situation ; it is personal and individual, and it is acquired during the lifetime of its possessor. Habits are often formed or broken under the motive force of an instinct or instincts, but in their essence, they are specific, they are the hallmark of their owner.

Are there not, however, acquirements which may be described as *general* habits, such as politeness,

punctuality and neatness? The answer is probably that in so far they are general, they proceed not from habits exclusively, but rather from those tendencies which will be described later under the name of sentiments.

The bodily substratum of habit can only be guessed at. It may be imagined to be a set of paths of least resistance in the nervous system, worn by use, while the instinct is dependent upon similar paths the resistance of which has been low from birth onwards.

The Control of Instinct.

Thus far, describing the instincts as the motive forces of behaviour, we have merely referred briefly and metaphorically to the guiding rôle of intelligence. A problem which would probably occur to the reader, even if it were not raised here, is how intelligence *can* control instinct. For, he may rightly object, in the limiting case at least, intelligence is notoriously unable to restrain instinct's imperious demands. Intelligence often sees quite clearly that the path to be followed by instinct is inefficient, stupid, wrong. Yet how many people complain bitterly that approving the better they follow the worse? Here again we can give no more than the briefest sketch of a possible answer to this; one of the greatest of all psychological problems.

In order to understand how instincts are controlled it is useful to imagine the behaviour of the ordinary man if he were at the mercy of each instinct as it was aroused by the appropriate objects around him; if every object which might tend to excite his fear, his anger, his disgust or curiosity, did so, and in full intensity. To an external observer the man's

behaviour would be chaotic, unstable, unpredictable (unless the onlooker knew beforehand all the objects which were likely to lie in the path of our purely instinctive man) and in a high degree it would be unsocial, in the ordinary sense of the word. It would resemble the behaviour of a very young child, for in the normal human being, control over instinct begins at an early age. What are the chief influences which usually counteract these primitive tendencies, and bring it about that the ordinary man's behaviour under usual conditions tends on the whole to be orderly, predictable (at least broadly so) and social?

The first and usually the most important influence is the coercion which is brought to bear upon him by his physical and social environment. He soon learns that certain objects in the physical environment when approached, touched, examined or eaten, give him pleasure, while others produce in him an opposite affective experience. The natural rewards and punishments administered automatically by the physical environment tend to "stamp in" or "stamp out" of his organism certain tendencies to behaviour. Only a little less automatic than these are some of the social rewards and punishments; those at least which are material in their nature, simple and inevitable. The wages which are normally the result of useful work done, the legal punishment which follows detected crime; these stamp in and stamp out tendencies in much the same way as do the agencies from the physical environment. Social reward and punishment may of course take the immaterial but real form of social praise and blame, or the subtler form of social approval or disapproval, the existence of which is known to the

person in question. In modern society these latter forces are usually very potent regulators of conduct, though it is only later in these lectures that it will be possible to do justice to their real power.

Are we, however, justified in attributing entirely to the simple coercion of the physical and social environment the control over his primitive instincts which the normal adult undoubtedly possesses? There are insuperable difficulties in the way of doing so, though it will be readily granted that much of what is popularly called the moral behaviour of mankind owes its existence in a very large degree to the presence of these social flanges which prevent the individual from running off the rails. Yet in most minds very powerful regulators of conduct, proceeding rather from within than from without themselves, exist in the form of what McDougall, following Shand, calls the *Sentiments*. The nature and the function of a sentiment are so important that we must now attempt to understand first, what a sentiment is, and secondly in what way it is related to the instincts.

We will proceed from the obvious and important fact that in adult man an external situation very seldom provokes one single and simple instinctive reaction, but usually tends to bring about more or less complicated behaviour in which the action of more than one instinct is noticeable. The affective aspect of this phenomenon is therefore that the emotion experienced is also not simple but compound.[1] In ordinary life a man seldom experiences pure instinctive fear; the animal fear, for example, that he might feel if, without any warning, a lion sprang upon him. More often he feels fear blended with some other

(*Footnote*) 1 cf. pp. 154-6.

emotion, and since fear of the unknown is one of the commonest kinds of fear he is not unlikely to experience a blend of fear and curiosity which will be pleasant or unpleasant according to the respective intensity of the former and the latter ingredients.

The fact that emotions tend to occur in blends has very far-reaching effects, the importance of which has been recognised by some modern psychologists. McDougall points out, for example, that admiration is a complex emotion, of which wonder is one constituent, but not the only one. For example, we may wonder at, while not admiring, the cruelty of a child towards a small animal. The other essential element in admiration is negative self-feeling or subjection; the recognition that we ourselves cannot, though we would like to, do or be what is admired. Genuine admiration, as McDougall says, implies a certain humility and generosity.

As we have seen, certain objects in man's environment tend to excite in him more than one instinctive tendency and the emotion connected with it. Some of these emotional tendencies, being frequently aroused simultaneously, become "grouped about" the object;—one might say that the experience of such blended chords of emotion becomes frequent for the individual. This tendency will spread also to the idea of the object in its absence, and thus there will be laid the foundations of a "sentiment," in the sense in which the word is used by Mr. A. F. Shand.* A sentiment may be

* "Character and the Emotions," *Mind*, New Series, vol. V.
"M. Ribot's Theory of the Passions," *Mind*, New Series, vol. XVI.
The Foundations of Character, London, 1914.

defined as an organised system of emotional tendencies centred about some object.[1]

This definition is so closely packed with meaning that a few comments upon it may not be out of place. First, we must notice that not emotions but emotional *tendencies* compose the sentiment. Strictly speaking, that is to say, we never experience a sentiment, but a sentiment is "a feature of the complexly organised structure of the mind that underlies all our mental activity."[2]

In the same way that one's bank-balance, though a most important feature of the complexly organised structure of finance as it affects us, is something which one can never be said really to experience, so it is with sentiment. The bank-balance may be described as an organised system of tendencies to enjoyment; it is no more.

The next important word in the definition is "object." An instinct is commonly aroused by any member of a large group of objects, that group being one which for biological reasons would excite the instinct in any member of the same species. A sentiment, on the other hand, though it may exist in connection with a group of objects (usually, however, a small group) commonly tends to adhere to one object. In other words, while the instinct is public the sentiment is private property, which has grown up during the lifetime of the individual and owes its character very largely to his environment. A sentiment, like a habit, is personal and specific.

This must not be taken to imply that a sentiment cannot be formed in connection with a *class* of objects.

1 McDougall, *op. cit.*, p. 122.
2 McDougall, *loc. cit.*

What it does mean is that the formation of such a sentiment is notoriously rarer, because more difficult, than that which occurs in connection with a single object. A mother may love all children, but the loves which she bears for her own are often quite distinct from each other, and certainly quite different from, and more intense than, those borne for children in general. A sentiment, then, is in a very real sense distinctive of the person who possesses it.

Lastly, the emotional tendencies in a sentiment are grouped into an organised system. And the importance of this will be clear when we come to discuss certain looser collections of emotional tendencies which are not so organised. The sentiment of love exemplifies the organisation of emotional tendencies. It may come as a shock to the reader when he realises that, according to this use of terms, he can never be said to *experience* love at all. The blow will be softened, however, by the discovery that what he does experience is an almost infinite series of complex emotions, the arousal and blending of which are due to that organisation of his mind called the sentiment of love. In this way it is possible to account for the fact that we may quite truly be said to love another even when the idea of the person is not present in our mind,* or when we are experiencing no special emotion. To put it in another way, love, being far too important to be classed as an emotion, ranks among the sentiments.

The reader will see quite clearly how the sentiment of love which one person bears for another may give

* The interpretation of facts such as these is presenting vast problems to twentieth-century psychology, but there is obviously no possibility of entering upon their discussion here.

rise in him at different times to almost any emotion or blend of them.

> Thus, as Shand points out, when a man has acquired the sentiment of love for a person or other object, he is apt to experience tender emotion in its presence, fear or anxiety when it is in danger, anger when it is threatened, sorrow when it is lost, joy when the object prospers, or is restored to him, gratitude towards him who does good to it, and so on; and when he hates a person he experiences fear or anger or both on his approach, joy when that other is injured, anger when he receives favours . . . It is clear . . . that the objects of these two very different sentiments may arouse many of the same emotions, and that the two sentiments comprise emotional dispositions that are in part identical, or in other words, that some of the emotional dispositions, or central nuclei of the instincts, are members of sentiments of both kinds.[1]

A comparatively small alteration of the relative intensity of the ingredients in the sentiment of love may change it to hate, though it is quite probable that something more is needed, that the *sine quâ non* of hate may be the absence of tender emotion. Such a considerable transformation is possible in all the sentiments; it may be compared to the vast changes often brought about by the slightest modification in the chemical composition of a substance. And perhaps like the chemical compound too, the sentiment may decompose, under great stress, into simpler and less organised entities.

THE CONCEPTION OF THE "COMPLEX."

It is perhaps not unfair to say that while this conception of the sentiment was growing in the relatively

[1] McDougall, *op. cit.*, p. 124.

quiet fields of normal psychology, another idea, in many respects very similar to it, was developing as a result of attempts made in the medical sphere to trace out the chief branches in the tangled undergrowth of abnormal mentality. The "complex," which may be described as a system of ideas, invested with a certain emotional tone, and tending to produce action in a definite direction,* while similar in many ways to the sentiment, differs from the latter in just those characteristics which are the results of the surroundings in which it has grown up.

The conception of the complex is wider and looser than that of the sentiment. A complex may be the result of the conflicting tendencies to action which spring from two or more opposing sentiments; on the other hand, it may be merely an unorganised sentiment, a sentiment which has not yet "arrived," a collection of emotional tendencies which cannot yet be described as a system, nor even as grouped—though they are already assembled—about an object.

We may take as an example of this unorganised state a stage in the growth of a sentiment like hatred. For weeks or months before a person becomes clearly aware that he hates another, his mind may be less placid, his behaviour less ordered and predictable, in the actual or imagined presence of that other. In fact it is probably just the dawning awareness of the interruption of the even tenour of his life, this appearance of new interests, simultaneously with a loss of the old ones, before the cause of these changes becomes clear to him, which may denote the "complex"

* Cf. Bernard Hart, *The Psychology of Insanity*. Cambridge, 1914.

stage of the developing sentiment. In such a stage the person's mind is just as likely to reject as to accept the true explanation of the irregularity of his conduct ; he may even strive not only to pretend ignorance of the cause but to deny that anything unusual has happened. The complex, to use technical language, may be repressed. Yet, although the instinctive energy suffusing it be denied an outlet through its normal channels, it may find satisfaction along devious routes, manifesting itself in such everyday phenomena as absent-mindedness, forgettings of duty, slips of the tongue, or slips of the pen. When, however, some of the causes of the complex are clearly recognised by the person there may arise the sentiment of hatred, which, if acknowledged by him, will tend to affect his conduct in a manner much more predictable and more conducive to action of an efficient and unequivocal nature; however unpleasant it may appear from the point of view of the person hated.

It is clear that a complex of great force and of a potentially mischievous nature is likely to arise when two or more well-developed sentiments, both possessed of great driving power, conflict with each other. A man's love for his child and his love for abstract justice may very well produce such a state of conflict. Yet society would be likely to judge any man in whom this conflict was of long duration to be morally weak. Why? Because to the successful fulfilment of social duties there is necessary more than the possession of many and strong sentiments ; they must be organised into systems in which some are subordinated to others. Otherwise their possessor is adjudged, and rightly, to be a mere sentimentalist.

But in what ways can this organisation of sentiments, without which the higher moral life is impossible, be achieved? By the moral education which is derived from the social influences under which the person lives; his family, his school, his church, his associates, and if he be fortunate enough to possess the leisure, money and the taste for them, his books. Can society, then, reasonably expect people who have had few or none of these advantages to possess strong, enduring and organised sentiments not only for the concrete individual objects of their environment such as their children and their homes, but also for great inclusive ideas, like the love for humanity in general, or the conception of their everyday work as social service? No system of education which aims merely or chiefly at supplying intellectual apparatus to the growing mind will help in the slightest degree to bring about these desirable ends. For though intellectual factors play a part in the inculcation of the sentiments, it is the emotions which give them their driving force.

We have seen that the effect of a complex is to render behaviour unpredictable (not only to an outside observer, but to the individual himself), more than usually unreasonable, and to make it impossible for the mind to attain and preserve that integrity, serenity, and calm which are necessary for continued efficient action. If this analysis of such disorders of conduct be correct, it should point the way to the rational cure for these ills. It is not unreasonable to suppose that an examination of the way in which the mental healing of the individual is possible will help us in the vaster problem which now lies before us and our children, the mental healing of the community.

Many modern physicians believe that the only rational and scientific treatment of a mental disorder is first of all to discover the complex or system of complexes which are disturbing the mind, then patiently to trace their history in the past life of the individual, until a point is reached at which the reasons for the original development of the complexes are discovered. Analysis and disentangling follow: the original causes of the beginnings of the disordered conduct are not only made clear to the patient, but he is encouraged and helped, first to face them in the light of his new knowledge, and then to assimilate them into the organised whole of his experience, so that they exist no longer as foreign bodies, denied admission to consciousness and compelled therefore to enter it in disguised forms. After this disentangling and "straightening"—to use Samuel Butler's term—there comes a period of re-education, in which the twisted, warped sentiments are fashioned anew into useful instruments which will enable the patient to meet the problems of his life with more effectiveness and zest. Conflict between the warring mental forces is resolved, and the emotional tone of the complexes is transformed into that of organised, effective sentiments.

We need not underline with too heavy a hand the possible applications of these successful therapeutic measures to problems not only of medicine but of industrial life. To possess the capacity for a sentiment like hatred is probably a sign of a healthy animal constitution; it may be a valuable asset in life, provided that the hatred is turned towards the right objects. But to spend one's days dominated by distrust, suspicion, by the haunting feeling of insecurity

is unhealthy in every sense; and is it not these complexes which characterise the industrial unrest of to-day? Merely to say nowadays that workers should be actuated by the same sentiment of duty to the community which they showed during the war, and to say nothing else, or to see no other problem ahead, ignores the fact that the war merely postponed the settling of many important differences between capital and labour—that it provided the opportunity for a powerful sentiment temporarily to over-ride the effect of complexes of many years' standing.

In his study of working-class psychology, from which we have already quoted, Mr. Ordway Tead has given many examples of the way in which the human instincts affect conduct. The reader will find in that book examples of the way in which, at critical times, the forces of instinct have burst through the dams which society has erected against them. Mr. Tead, however, has confined his description almost entirely to the action of the instincts themselves. The present essay is an attempt to supplement, in some degree, this exposition by an account of the way in which instincts are normally controlled, and to help to make clear the part which moral education plays in such control.

We may conclude this brief and inadequate sketch of the forces which lie behind human conduct by pointing out once more some of its main features. The last sixty years have provided psychologists with advances in knowledge, which help them greatly in understanding this problem. The first is that the mind of man, like his body, can be understood only in its relation with the minds and bodies of the other

animals, to which he bears such obvious resemblances; the second, that we can believe no longer that man's intellect or reason is alone capable of guiding his conduct; the third, that the common assumption that the individual himself is aware of all the reasons for his conduct is a delusion. The sentiments, those forces which, while they have partly grown out of instinct, yet can control it, may develop in an orderly or disorderly fashion; they may pull together in the mind, or they may split it asunder. The very specificity of man's habits, those quasi-automatic ways of behaviour which are so largely the product of his environment, supports the belief that a change of surroundings or of outlook may play an enormous part in bringing about change of habits; has not the experience of the last few years shown this over and over again? Lastly, the education of the future must aim at helping people not only to know, but to desire the right things.

At this point we hear, from the armchair of some comfortable member of the resistive brigade, the objection: "But you cannot alter human nature!" For him we should like to be allowed to prescribe a course of psychological study. He should be asked to examine patiently, in turn, not from his armchair but at closer quarters, the mental processes of a maniac, a drink-habitué who still remembers details of the decent life that he once lived, a person in deep hypnosis, a dissociated personality, and then, as a pleasanter reward for these labours, children whose very mentality has been altered by the unceasing devoted efforts of their teachers; the blind and deaf Helen Keller, brought "out of the dark" by education, the slum babies, turned from weeds into flowers by Dr. Montessori,

the good citizens in our own country whose goodness would have had a poor chance of showing itself but for the " Little Commonwealth " of Mr. Homer Lane.

The fundamental roots of human nature may remain the same, yet the growths above them are eternally transforming. No longer is man content to remain a passive example or an uncomprehending spectator of these changes; in future he will insist upon participating actively in them, and with opened eyes.

PART IV.

LECTURE VIII.

Industrial Overstrain and Unrest

By CHARLES S. MYERS, M.A., M.D., Sc.D., F.R.S.

UP to a certain point fatigue is healthy and health-giving, so long as it is dissipated by rest. But when work is resumed before previous fatigue has passed away the path is entered which, if persisted in, can only lead to overstrain and its consequences.

In order to reach a more exact conception of the nature of overstrain let us inquire into the nature of fatigue, of which it is the pathological expression, and let us first confine ourselves to muscular fatigue.

There are several physiological views conceivable of the nature of muscular fatigue. One is that living matter becomes fatigued when it has used up all the stuff available for its activity, and that it then needs rest, during which it manufactures fresh stuff for its subsequent use. This conception of muscular fatigue as being due to the exhaustion of consumable fuel is probably in fact never seriously realised. There are at least three other kinds of fatigue which step in and prevent our muscles being reduced to such an *impasse*. The nerve fibres which carry impulses terminate in the latter in delicate "end-plates," which are "fatigued before the exhaustion of the muscular tissue itself."

Another physiological conception of fatigue is that it arises from the working parts of the organism becoming choked with the products of their own decomposition. Muscular tissue during contraction breaks down to yield carbonic acid, lactic acid, and other substances. If these are allowed to accumulate in the muscles faster than they can be removed therefrom by the lymphatics and the blood stream, they impede more and more the activity of the muscles. But the onset of this second conceivable source of muscular fatigue is likewise usually safeguarded by the action of the central nervous system, the synopses of which—*i.e.*, the points of contact between adjacent nerve cells—are peculiarly susceptible to the effects of drugs and poisons. The probability is that when fatigue acts on the synapses in the brain and spinal cord we have to do with a certain nervous fatigue not in the sense of exhaustion, but as the result of an accumulation of waste products, a chemical poisoning, which leads at first to a more or less purposeful change of function—*e.g.*, to a central blocking, reversal, or inhibition of nervous impulses—but later to a complete disorder of central nervous function, involving inco-ordination and loss of higher control; for the nervous system is to be regarded as a system of relays of nerve cells, the higher controlling the lower, the higher being the more recently acquired and the more susceptible to the effects of drugs and fatigue.

But such domination of one nerve cell over another cell extends beyond the nervous system. In its control over the muscular system the nervous system protects it from fatigue. When a muscle is voluntarily contracted it sends impulses up certain nerve fibres to a nerve

centre, the effect of which is to inhibit or suppress the nerve impulses which would normally pass down and produce further contractions in that muscle. This is what occurs when a single muscle is exercised to lift a given weight by willed rhythmical contractions. The contractions become less and less, until at length the inhibition is so great that no amount of voluntary effort can produce further movement in the muscle. But the muscle itself is not fatigued in either of the two senses in which the term has been here used: it is merely inhibited by central nervous activity. The musculo-nervous apparatus is placed *hors de combat* only to a given condition, that of being subjected to a given strain, that of lifting a certain weight. If the weight be replaced by a slightly smaller one a fresh set of excellent contractions can be voluntarily obtained; or if an electric current be employed to stimulate the nerve, the muscle can be proved to be still capable of work. In other words, central nervous control sets up inhibitory processes which are a safeguard against the evil effects of monotonous muscular excitation.

In monotonous *mental* work a similar protective function can be seen. When we are engaged on any one piece of mental work other mental processes are inhibited which are incompatible with it; but the effects of fatigue are safeguarded by the gradual failure of these processes of inhibition. The inhibited mental processes sooner or later refuse to be suppressed. Other mental activities accordingly intrude, and by *their* inhibitory action make the continuance of the monotonous mental work impossible. The continued effort to repress these intruding activities is accompanied first by a feeling of "boredom" as interest—*i.e.*, the

pleasure or incentive in the work—wanes, and later by a feeling of "weariness" as the effort is invoked with greater difficulty.

The boredom of any monotonous occupation is thus a warning against the continuance of that occupation. It betokens an impairment in the efficiency of those processes of inhibition which enable us without undue conscious effort to concentrate on a single activity. In practice the need for conscious concentration is greatly lessened by habit. But even when an often repeated action has become so automatic as to be performed better without conscious attention, nevertheless a special "attitude" has always to be preserved, and fatigue sooner or later arises in the inhibitory effort to maintain that attitude; otherwise the repressed activities grow stronger, and at length burst their bonds. Hence even in such automatic monotonous industrial occupations as labelling, adding, or letter-sorting, feelings of boredom and weariness arise; and finally even such warning neurasthenic experience as "I could shriek. I feel as if I want to hit somebody."

Boredom can be alleviated by increased interest or by rest. In its earliest stages any ill results may be prevented by a change of occupation, but where serious effort of the will has been made to keep the attention concentrated and to overcome such feelings of boredom, change of interest or of occupation is no remedy. Higher control is actually fatigued and cannot be immediately employed for concentration in another direction; for the synapses concerned in the effort of the Self at inhibition are most sensitive to fatigue, and this fatigue enters into and affects other subsequent self-effort.

We conclude, then, that monotonous application for long hours at relatively light work induces an incapacity as serious as employment for shorter hours at more strenuous work. Indeed, the incapacity may be more serious—*e.g.*, when the lighter work is mainly of a mental character, watching and controlling a small piece of machinery that does everlastingly the same job—and when the heavier work is mainly of a mechanical character—*e.g.*, lifting huge weights of iron. In the latter case the main source of fatigue arises, as we have seen, from the accumulation of waste products in the muscles and especially from the nervous inhibitory processes arising from unchanging muscular exercise. But such nervous inhibition has its seat in far lower and less important nerve centres than in the former case. The volitional efforts made to overcome such muscular incapacity are much less effective and less baneful than those made to overcome the boredom and weariness arising from mental work. Hence the pathological expression of continued fatigue—*i.e.*, overstrain—is far less prevalent in muscular than in mental exertion.

It is, therefore, the ineffective effort on the part of the Self that results in what is called nervous exhaustion, nervous breakdown, or neurasthenia. It is the result of a failure of the higher controlling centres; and as the result, in turn, of this failure the forces of the incoming stimuli, which the brain and cord are ever receiving, instead of being "absorbed into the larger harmonies of the nervous functions, fall to "short-circuiting," wherein their energy is wastefully dissipated."* Thus arise the

* Allbutt's *System of Medicine*, 1910, vol. viii., page 741.

irritability, restlessness, insomnia, and loss of self-confidence, so characteristic of neurasthenia. There is a shortage of storage capacity, the brain feels tired, headache and weakness of vision arise, there is a general loss of muscular tone throughout the body, in the muscles of the vascular and visceral organs,as well as in those of the limbs. The legs feel tired, there are pains in the back and stomach, kidneys, liver or heart tend to slip from their moorings, the digestion suffers, the whole abdomen shows want of tone. Such visceral tone is lowered owing to disturbance in the normal impulses passing along the sympathetic and vagus nerves. These nerves also control the organs of internal secretion, the endocrine glands—*e.g.*, the adrenal glands, the thyroid gland, etc. Disturbance of their function causes disorder of the emotions. Disturbance of the vascular and digestive systems causes these and, in addition, other mental disorders. Thus disorders on the bodily side of the organism become reflected in disorders on the mental side.

Far more important, however, is the converse relation which the mental disorders directly induced by overstrain exert on bodily processes. This aspect of nervous exhaustion has only received its due prominence through a study of the cases that have arisen during the stress of the recent war.

The failure of higher inhibition results, on the psychical side, in a loss of control over various unpleasant experiences of the past which, through such controlling inhibition, have hitherto been—often unconsciously—repressed from consciousness. Fatigue impairs this inhibition, and the past memories are now able to surge forth from the unconscious to which they

have been banished. Thus the mind becomes tormented with past emotional experiences. Neither over the worries of the past nor over those of the present has the Self any adequate mastery, and it has no longer the power to view them in proper perspective. They are like restive horses which have escaped from control and bolt away, carrying the driver with them.

The higher the race or the more cultured and educated the individual, the more complete is usually the control of the intellect over the emotions, the more readily are the primitive emotions of fear, anger and love dominated by such higher intellectual sentiments as loyalty, conscience, or duty. Under certain conditions this domination fails, however—*e.g.*, when the lower emotions become so powerful that it is humanly impossible to restrain them, or when the higher centres of control have been enfeebled through fatigue. So, too, in industrial overstrain the fears and worries of the past, arising, it may often be, from events that cannot be recalled, emerge from the unconscious and inexplicable phobias and obsessions appear in the field of consciousness.

In some cases rest and recuperation of the nervous system suffice to restore the previous inhibition, and thus once again banish such phobias and obsessions into the subconscious, with the restoration of self-control. But in a very large number of cases the surest and speediest method of cure consists in an exploration of the patient's mind in order to discover the forgotten scene of origin of these emotions. The three methods employed for resuscitating such forgotten experiences are those of (1) single free associations; (2) serial free associations; and (3) hypnosis. These methods merge

one into the other and are dependent on one and the same principle—an appeal to the unconscious. They yield full knowledge of the forgotten distress which caused all memory of the scene to be repressed. The patient can now attach his emotion of fear or anxiety, or his obsession, to its original cause. He can now understand the origin of such distressing experiences, and by reassociating what had been dissociated, and by boldly facing instead of running away from what he would consciously or unconsciously banish from his mind, the unreasoned emotion which had arisen from the unconscious owing to the loss of higher control consequent on the overstrain comes again under control and no longer holds the field.

But the loss of higher control caused by overstrain not only results in the awakening of unreasoned and causeless emotions connected with "shocking," horrid and, hence, dissociated experiences of the past. It is also evinced in the failure to deal with emotional experiences of the present. The overstrained person is naturally irritable. He is prone to be unduly sensitive. He loses his perspective of the relations between himself and others. He attaches inordinate importance to trifling lapses from morality on his part or to small injuries received from others. He hugs his fancied or exaggerated sins, grievances, sorrows, or disappointments, and is unable to dismiss their worries from his mind.

Finally nature may come to his aid by the process of "projection." Instead of continuing to reproach himself, he may quite involuntarily turn to believing that others are speaking ill of him. Thus may arise delusions of persecution or suspicion. This is only one

of several ways in which the source or character of an emotion may be unconsciously changed in order to screen the Self from the effects of undue depreciation and abasement. Another method is that of "inversion"—*e.g.*, shyness may become inverted into boisterousness, subservience into defiance, cowardice into foolhardiness, the desire for the opposite sex into hatred of it, and so on.

Such "defensive mechanisms," as they have been called, may unconsciously come into play in any insoluble emotional situation. And I strongly suspect that the processes of projection and inversion are in some degree—though, of course, far from wholly—responsible for the present spirit of industrial unrest. Employers and employees have much to reproach themselves for, and in their attempts to escape from the consequent self-depreciation fix the blame on the other. Moreover, the spirit of revolution is especially favoured after the overstrain of the past five years; and the pre-war emotions of resentment against industrial injustice are revived in enormously intensified form.

That such overstrain widely exists needs little proof. I know myself the managing director of a factory who, with his works manager, burst into tears when the latter came to him with the news of the armistice. The editor of an important London daily newspaper told me that his assistants were breaking down one after the other when the strain of warfare was at an end, and that they were so sensitive that even the mildest rebuke provoked an outburst of emotion. Which of us has not in some measure had the same experience?

We have evidence that during the war workers

complained of feeling "stale," "nervy," "done-up, "or " fairly whacked " ; that the result was " lethargy and indifference " on the one hand and a " craving for excitement " on the other.

When the life of a nation is at stake overstrain must be in some measure inevitable. Yet no one now doubts that economically the long hours of work, the introduction of Sunday labour, and the prevalence of overtime adopted soon after the outbreak of war, were unsound. A far greater output could have been—and, indeed, in the later years of the war was—secured by proper regulation of the working hours ; and the danger of overstrain was correspondingly reduced.

We are now reaping the fruits of the strain of warfare. In all departments of industry and commerce slackness, distrust, suspicion, irritability and defiance abound ; and as they pass away we are bound to devise methods whereby such overstrain may, so far as possible, be prevented in the future.

The hours of labour and the periods of rest must be regulated in different industries according to the nature of the occupation involved.

The monotony of work must be, so far as possible, reduced (a) by augmenting the worker's interest in his task. This can be affected (1) by improvements in status and incentive—*e.g.*, by increasing his industrial knowledge, control and pay—and (2) by reducing needless discomfort. (b) By lessening the time spent on monotonous work. This can be effected by periodic changes in employment, especially by each employee being trained in part of his working hours for some higher occupation, and by his training some fellow workman to undertake his work. (c) By carefully selecting those

employees for monotonous work who have no great desire for variety of occupation.

Knowledge of the source of one's disordered emotions is, as we have seen, the best means of gaining control over them, and knowledge of one's true relations with one's surroundings and fellow-creatures is the best preservative of self-control. So long as the worker is treated as a mere animal, so long as he is kept in ignorance of the place he holds and of the duties he owes in the industrial world, so long as he remains in servitude as regards industrial management, he cannot be expected to apply the intellectual forces of reason and the loftiest sentiments to the mastery of his lower instincts and emotions.

A properly organised whole-time Industrial Medical Service of physicians specially trained after graduation, and adequately paid, must be instituted, comparable to that already in existence for the maintenance of public health. They must have received such technical instruction as will enable them to obtain a diploma in industrial medicine, which needs to be established forthwith on lines comparable (perhaps sub-ordinate) to the existing diplomas in public health, and psychological medicine. This Service must be added to that of the lay Inspectors of Factories and Mines, and its officers must be provided with executive, not merely with advisory, powers. They must be familiar with the initial signs and treatment of overstrain, and they must be alive to the importance of its early detection and its diagnosis from mere slacking or malingering. They must be assisted by the reports of the foremen and welfare supervisors, they must be allowed access to the records of output, spoiled work and absences, which

in every well-organised factory should be available, so far as possible, for each worker. They must be familiar with the conditions of the different industrial processes with which they will be brought into contact, and with the effects of abnormal conditions of temperature, humidity and purity of the air; they must realise the economical advantages of properly distributed working and resting hours, of properly arranged canteens and welfare departments, and of properly apportioned loads to be lifted by workers of different ages and sex. They must be acquainted with the current psychological and physiological tests for the selection of young workers according to their innate capacities.

The training of such medical officers and the scientific research involved could be conveniently carried out at the proposed National Institute of Industrial Psychology and Physiology, which only needs further financial support to start its invaluable career. Among its functions would be vocational guidance and the training of those engaged therein in Labour Exchanges and on Juvenile Advisory Employment Committees.

Finally, adequate provision must be made for clinics and sanatoria—on the same lines as those already established for tuberculosis—suitable for the treatment of initial and serious cases of nervous breakdown. These were established successfully during the last years of the war for neurasthenic soldiers; but most of them, instead of being taken over by the Ministry of Pensions and being passed over by them to the Ministry of Health, have been allowed to close*; and many of the best medical officers, specially trained, who worked in

* It is but fair to add that others have had to be recently opened.

them have returned, often against their wish, to private practice. Very small beginnings are now being attempted at Oxford, Cambridge and one or two other centres, but generally there is no provision for the early recognition and proper treatment of overstrain in civil life throughout the country.

Until such treatment has been provided, until some Institute of Psychology and Physiology applied to Industry and Commerce has been established, until a whole-time Industrial Medical Service and University Diplomas in industrial medicine have been instituted, we cannot be said to have learnt the lessons of this war in regard to industrial overstrain and unrest.

LECTURE IX.

The Demands of Industry upon Women from the Physiological Standpoint

By WINIFRED CULLIS, D.Sc.

THE work of women in industry is, in the main, work involving muscular activity, and the first requisite for the understanding of the demands of industry upon the individual is some knowledge of the fundamental processes underlying muscular work. These processes are, as we shall see, similar for all muscular actions and therefore, broadly speaking, investigations into the effects of industrial work upon the worker and into the best conditions for its performance can be carried out by studying the work and the conditions under which it is done independent of the sex of the worker; for though normally the muscular system is more developed in the male than in the female, the difference is one of degree and not of kind.

The special problems which may arise in connection with the greater share taken by the female organism in reproduction, will be considered separately, but there will be a much better understanding of the whole question of women in industry, if it is realised that for

its performance muscular action requires the fulfilment of certain basic conditions which are independent of the sex of the worker. As movement—and movement in the main is carried out by muscles—is such a fundamental manifestation of life this is to be expected.

At the outset of our study into these basic phenomena we may state that every muscular action, however simple, involves the proper functioning not only of the muscular but equally, though less obviously, of the nervous system, for no single action in the body is carried out by one muscle; in every action numbers, in some cases hundreds of muscles are involved. Each muscle taking part must work in harmony with the others, one contracting, another relaxing, and this necessary co-ordination of action can only be brought about by the intervention of the nervous system, which acts as the communication line, and as the centre receiving and dispatching the necessary directions at the right moment to the muscles concerned.

The changes occurring in muscular action in the delicate and much less bulky elements of the nervous system, nerve cells and fibres are not so easily followed as the more obvious ones occurring in the muscles, which moreover are themselves the cause of certain effects produced upon the nerve elements and we will therefore study first the changes which occur in the muscles when they work, or "contract" as it is technically called. The term "contraction" is used because in many cases (the raising of the forearm for instance) the movement is effected by the approximation of the two ends of the muscle by its shortening (or contraction). The same term is used for the changes in the muscles in other actions, *e.g.*, the carrying of a heavy

bag, where certainly work is done but no shortening of the muscle takes place.

By the observation of suitable preparations, such for example as the isolated gastrocnemius muscle of the frog, it can be shown that on contraction the following changes take place :—

(*a*) *A shortening*, which involves alteration of form but no change of volume, the change of length (when recorded) being found to take the form of a wave of contraction starting from the point of stimulus. By means of this shortening the muscle can be made to perform external work. During the contraction the muscle also becomes more extensible than it is in the resting condition,—this is obviously a protective mechanism helping to prevent the rupture of the muscle fibres when the strain is suddenly thrown on to them.

(*b*) *A production of heat.* This is a matter of common experience as it is generally recognised that the taking of muscular exercise is the best way of getting warm. The energy of the muscle contraction is divided between work and heat production. As in an engine so in a muscle efficiency is measured by the ratio $\frac{\text{work}}{\text{heat}}$; and under certain conditions it is found that the muscle as an engine outclasses all others.

(*c*) *Chemical changes.* A production of carbon dioxide and of an acid, lactic acid, closely related to the acid produced in the souring of milk. The chemical changes are of importance and one explanation given of fatigue is that it is due to the accumulation in the blood of these products of muscle activity. They are certainly the direct cause of the increased respiration which is such a well known and beneficial effect of muscular exercise.

By making a graphic record of the contraction, it is seen that there are three stages in it (1) the " latent " period,—the time elapsing between the stimulation of the muscle and its obvious response ; (2) the period of contraction or shortening ; (3) the period of relaxation or returning to its normal length. By studying such graphic records of muscles made to contract under different circumstances we can study the effects produced by changes to which the muscle may be subjected in the living body. We then find that cold slows the contraction, lengthening the latent period and the period of relaxation more particularly, thus accounting for the clumsy action of cold hands ; that warmth quickens the contraction ; that loosing the muscle within limits is beneficial, so that a muscle works best when it is working against a resistance— all facts agreeing with every day experience.

Further, we can study the effects of long repeated efforts which lead to fatigue. A " fatigued " muscle gives on stimulation a contraction very similar to that of a cold muscle : it has a long latent period and such an exaggerated relaxation phase that if a second stimulus to contract is sent in at all quickly after the first the muscle has not returned to its normal length when it begins to contract again, and we consequently observe a clumsy inco-ordinated action in extreme fatigue. When we investigate the conditions leading to fatigue we find there are several, chief amongst which are the accumulation of the various substances produced when the muscle contracts and the using up of the stored material which on breakdown provides the requisite energy. In the muscle outside the body fatigue will come on more quickly as there is

nothing to carry away the waste products or to bring fresh food material from which the muscle can renew its supply of energy-producing substance. The part most susceptible to the accumulation of these substances is the point where the nerve fibre enters the muscle, the " nerve ending," the muscle itself being fatigued only after much longer action. In the muscle working inside the body the onset of fatigue is much slower, the circulation of the blood through the muscles serving the double purpose of washing away the waste products as they are formed and bringing to the muscle the food materials which it needs. This supply of blood which is so essential is improved by the muscular contraction itself as the carbon dioxide and lactic acid produced cause a dilation of the blood vessels in the muscles so that more blood flows through them from this local effect. Further the contraction of the muscles improves the general circulation. The muscles press upon the veins and push the blood on towards the heart since, owing to the arrangement of the valves, which are always abundant in the veins of muscles, the blood can only flow in that direction. Muscular work thus acts against gravity and helps to return the blood more quickly to the heart. This improved circulation benefits all the tissues of the body and amongst them the muscles, which thus benefit from activity in two ways.

The action on the circulation is one of the great benefits to the body ensuing upon exercise, another being the effect already mentioned of increased respiratory movements whereby the ventilation is improved bringing to the body more oxygen and getting rid of more carbon dioxide.

As a result of these reactions of the body as a whole to muscular activity the muscle tissue is so well protected against fatigue that it itself is practically never exhausted. Fatigue in the body is due to the effects on the cells in the central nervous system which control the muscular contractions, and is in reality a nerve rather than a muscle effect. This can be demonstrated by a simple experiment. If a very small part of a saddle shaped area of the shoulder of a dog is stimulated, the hind limb of the same side will perform forcible "scratching" movements, which, if the stimulus is maintained, will gradually become weaker, showing signs of fatigue. If then the point of application of the stimulus be moved very slightly to a neighbouring patch of skin, the movements start again with their original vigour, showing that the muscles and the nerves to the muscles are not fatigued but that the cell junction or "synapse" between the cells which receive and those which send out the messages to the muscles were "fatigued" so that the impulses were blocked. From a knowledge of these facts it is easy to understand that an operation involvihg a sequence of different movements is less fatiguing than one which involves the repetition of some particular movement, especially if this has to be performed in a cramped position.

These changes have been entered into at some length since it becomes clear from a study of them that the processes underlying muscular work and the production of fatigue, are inherent in the action of muscular contraction itself and are the same in the body of a woman as in that of a man. Similarly this must be true of the conditions which will prevent

fatigue and from what has been said it is obvious that conditions which will ensure a good circulation will be of supreme value in its prevention. A good circulation means an adequate supply of blood well provided with oxygen and with the essential materials from which the muscle can renew the muscle fibre itself as it is worn by activity, and also replenish the stores from which it obtains the energy of contraction. To insure this the individual must work in rooms well ventilated, with air of correct temperature and humidity, and he must be well nourished. In the past the nourishment of many women workers has been much below the necessary standard, partly owing to bad pay and partly to the fact that the woman worker has had to prepare her own food. Experience in factories in war time has shown that the proverbial lunch of the girl worker of a cup of tea and a bun was a matter of necessity and not of choice. Where wages were adequate and good wholesome food was provided, as was the case in large numbers of factories which ran good canteens, the female workers were found to take really good meals of the right type. Indeed, but for this, they would not have been able, as they were, to work longer hours at hard tasks with so little lost time for sickness. It was noticed in many cases that this, in spite of the hard work, was actually diminished and it is clear that from social and economic reasons which are obvious on reflection, the woman worker in the past tended to be underfed and for that reason was in many cases unable to do the best work and work which should be well within the power of a sufficiently nourished individual. Women workers should be deliberately encouraged to take good meals

of a nourishing kind. Under such circumstances it will generally be found that the chief condition to be taken into account in adjusting the work of women and of men is that as the average man develops more muscle than the average woman, some very heavy muscular work that can be done by men should not be done by women. Another condition which may be considered as affecting this question in quite another degree, is that women seem to be more sensible than men to unsatisfactory environment. Bad ventilation and high temperatures affect them more adversely, probably in both cases from physiological grounds. They are generally slightly more anaemic, and they have a deposit of fat under the skin filling up the spaces between the muscles, which may prevent them losing heat as easily as the men in whom this fat is less well developed.

If, however, from what has been said it is clear that the general problem of muscular contraction, and therefore of the onset and prevention of fatigue, from the physiological aspect, is in the main the same for both men and women, it is equally clear that the woman's function of child-bearing introduces into her normal metabolism, after puberty, phases which must be considered in reference to her ability to perform muscular work. The two important phases are menstruation and pregnancy. As for the former the normal healthy girl or woman should suffer practically no disability as regards power to do work during this period and though in individual cases there may be such disability, there is no ground for imposing on woman's work in general, restrictions based upon such individual cases. Recent careful experimental work does not

bear out the old contention that there is a monthly cyclical variation in the powers and activities of a woman. The fact that the condition is a normal physiological one should lead us to expect such a result. Just at the onset of puberty (in the absence of any definite knowledge in the one direction or the other, as to this point) it is probably wise in the case of both the girl and the boy to see that no extra strain is imposed upon the organism which from the nature of the changes occurring in it at this time is undergoing a certain readjustment of metabolism. But when this metabolism is once established it can be stated quite definitely that hard work under good conditions (good feeding is an essential one) should not exert any deleterious effects upon the physical health of a woman. The second condition (pregnancy) must be considered from the double standpoint of the mother and of the child. It may be pointed out that here the whole question of women in industry is being considered from the *physiological* point of view, but that for its complete understanding social and economic factors must be taken into consideration, though these, for their proper appreciation, need a basis of knowledge of the fundamental physiological principles. In the first place, it must be stated that physical work in itself does not interfere with the function of child-bearing either during the actual pregnancy or in the power to bear children, as is seen in the more primitive races where the women ordinarily do hard physical labour at all times. Other conditions may be of far greater importance. It is for instance essential for the health of the mother that she should be well fed, and often cessation of work means that a lower standard of feeding

has to be adopted. Obviously too, an expectant mother should not do a full day's work in a factory and also the greater part of the work in the home, as the pregnancy itself is throwing extra work on the organism. A reasonable amount of work is probably good as food is assimilated better under active conditions, and the active expectant mother tends therefore to be better nourished than the sedentary one. During the pre-natal period it is the feeding of the mother that has to be considered since it has been shown that if there is not enough food for both, the child grows and develops during this period at the expense of the mother.

Some interesting observations on the work of pregnant women in factories during the War have been made by Dr. Rhoda Adamson of Leeds (Prelim. report, *B.M.J.*, Sept. 21, 1918). She found that the work itself caused no injury, though at the latter end of the pregnancy it was desirable to put the women on to lighter work and more particularly to take them off night work which she found to be detrimental. By co-operation amongst the employers it was found perfectly possible to arrange for this. A series of workrooms were started to which the women were drafted about the fourth month of pregnancy and where their work could be graded according to their condition, the women receiving a fair fixed wage—milk and a good middle-day meal being also provided. This experiment was extremely successful and seems to have brought out one or two points very clearly: (1) that the women were most desirous of being allowed to continue working, (2) that there was less temptation to conceal pregnancy or to make use of abortifacients (again showing the desire of the women to remain at

work),(3) that the babies were as healthy as those of women who ceased working in the factories, although on the average a few ounces lighter.

With regard to the post-natal stage, as far as the mother is concerned she should not be allowed to return to full work for from five to eight weeks after pregnancy, according as to whether her work is light or heavy, but when she returns to work it is very desirable that for six months facilities should be provided whereby the infant can be breast fed,—after that time breast feeding can be supplemented by artificial feeding and only morning and night feeds from the breast given. The importance of breast feeding is very great, for though children can be reared successfully on artificial feeding, this requires much more care and time in preparation of the food than ordinarily can be given by a working mother, and it is doubtful even at the best whether artificial feeding is going to give quite the same chance to the child as breast feeding, apart from the fact that disorders such as infantile diarrhoea are much more common with the former. In this connection there are points of great interest to be met with, in consideration of the chemical composition of the milk.

Modern work on the physiology of foods has shown that every species of animal builds up its own specific kind of flesh, and that those foods are the best for the animal which bring to it the special constituent groupings and compounds which are incorporated in its own tissues and in proportions which most nearly resemble those of the latter. These foods are necessary for the maintenance of the fully developed organism, but for the growing animal other materials are also

essential and necessitate the taking of foods containing them, though the actual quantities in which they are present may be astoundingly small. These substances are called " vitamines." Now, though almost any milk seems to contain the vitamines necessary for growth we find there are great variations as regards the proportions of the more important constituents which are, generally speaking, water, proteins, sugar, fats and inorganic salts. If we compare the composition of the milk of different animals, we can at once see an adaption of the composition to the needs of the young. As regards proteins, we find a relationship between the amount and the length of time the young is fed by the mother. Expressing this in terms of time the young takes to double its weight we have the following figures (quoted from Lusk's *Science of Nutrition*) :—

	Time in days for new born animal to double its weight.	100 parts of milk contain Protein.	Ash.	Calcium Oxide.
Man	180	1.6	0.2	0.328
Horse	60	2.0	0.4	0.124
Calf	47	3.5	0.7	0.160
Kid	19	4.3	0.8	0.210
Pig	18	5.9	—	—
Lamb	10	6.5	0.9	0.272
Dog	8	7.1	1.3	—
Cat	7	9.5	—	—

Another comparison may be given between human and cow's milk :—

	Cow	Human
Protein	3.41	1.52
Fat	3.65	3.28
Milk sugar	4.81	6.50

This table accounts for the fact that undiluted cow's milk is difficult of digestion for a baby; it has too high a protein content. To overcome this difficulty milk must be diluted, but this obviously throws out the proportion of milk and sugar, which have therefore both to be added to the diluted milk. A milk can be produced of roughly the same proportions as regards the three important classes of foodstuffs, but even then the milk is not the same; the protein is different (though not very markedly) as regards analysis, and this is also true of the fats. Further, in the preparation of this so-called "humanised" milk, no account is taken of constituents such as other nitrogen-containing compounds, and of salts. For instance, the calcium content is different in human and "humanised" milk, as is also, very noticeably, the iodine content. In the newly-born human the thyroid apparatus,—which throughout life is bound up with the iodine metabolism, and is essential for the growth and well-being of the organism (absence of thyroid in the young leads to cretinism, and in the adult to myxoedema),—is very poorly developed, and the growing child depends for its supply of iodine upon the maternal milk, which contains it in sufficient quantity. In the newly born calf, however, the apparatus is more developed and approximates very nearly in its iodine content, in proportion, to that of the adult, and iodine is therefore present in much smaller quantity in cow's milk. As the thyroid is so essential for growth and its active constituent contains iodine, we may have here a very cogent reason for believing that a child fed on its mother's milk will have a better start in life than one deprived of its normal quotient of iodine.

For all these reasons it is obviously of great importance for the well-being of the child that conditions should be such that the working mother should be able to feed it from the breast in the first months.

Bearing in mind these fundamental physiological facts, there should be no difficulty in making arrangements such that those women who wish to remain in industrial employment through pregnancy, should be able to do so with benefit both to themselves and to their employers.

In conclusion then it may be reiterated that there seem to be no reasons from the physiological standpoint for any general and arbitrary limitation of women's work in industry, and that when well fed and working under good conditions, women are well able to do hard physical work. The problems of fatigue are very similar for both men and women; but in view of the shortening of the hours of work, the improvement of general conditions in factories, and the greater employment of labour-saving devices, it may be confidently and happily expected that such "fatigue" as is injurious to the individual will become less and less common, and that the efforts of scientists will be more usefully employed in working out conditions which will add to the efficiency of the worker and lead to a greater output at less cost of work.

To be well and sufficiently employed and to work usefully under wholesome conditions, are such great factors in the maintenance of good physical health and in the happiness of the individual, that it is indeed a study well worth while to find conditions which will allow of this for every individual, and for women no less than for men. It is a problem in which we can

ask and receive help from all those (and they are by far the larger number) who care for the health and happiness of the individuals of which a nation is made, and one which by co-operation between workers of all types, we can confidently hope will be well and satisfactorily solved.

LECTURE X.

The Practice of Industrial Welfare and Health

By EDGAR L. COLLIS, M.D. (Oxon.).

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EMPLOYERS who have seen references to, or have heard well of the welfare movement may be hesitating to introduce it into their own establishments until they grasp clearly the end and object to be attained thereby, and the best way to embark upon it. Delay in such cases is not without its justification. Wisdom calls to look before you leap. Moreover nothing is harder to rectify than a half-hearted welfare scheme which has earned not the trust, but the distrust of the workers. At the same time the movement has now gained such impetus that the interests of industrial concord, health and efficiency in each establishment demand that action shall not be long delayed; the leap must soon be taken, for greater danger may lie in procrastination.

THE END TO BE ATTAINED.

The first point to establish is that there is need for the movement. Once this is clear, the end to be

attained will be clear, viz. :—the removal of this need. Few employers have ever seriously set themselves to consider what is the relation of industry in general and their own industry in particular to the community; or realized that modern developments, due to the invention of power-driven machinery, have introduced a complexity into the social state previously entirely unknown. In the beginning the one necessary occupation was agriculture for the production of food, with other minor industries such as the manufacture of clothes and the building of dwellings as auxiliary trades. Industry existed then to serve the community and provide it with means for living as healthily as was then possible, with food to sustain life and with clothes and houses to protect against the weather. At the same time it reacted on those whom it served by stimulating to forethought in the use of their energies, and by drawing out their developing intelligence. Thus industry has been the ruling factor in determining the physical and mental evolution of the human race.* Surplus industry which is wealth gave rise to social distinctions, and out of these in the course of centuries grew civilised communities; at each stage the primitive purpose of industry became more and more overlaid. In the last two centuries industry has become vastly more complex than ever before; and in the complexity sight has practically been lost of the reason for its existence, viz. :—to serve the community. It appears now as never before to provide opportunities for those with special capacity to acquire prizes in the form of

* Writers such as Ricardo, Adam Smith, and Buckle seem hardly to have appreciated the primitive purpose of industry; and so failed to see that nations were doomed to decay when they relegated industries to slaves.

material wealth; and there is a tendency in seeking to acquire these prizes to forget they must not be won at the expense of the community or of a part of the community, or that prizes are only rewards for good scholars and not the end and object of education. Industry, while holding out these incentives, must remain the servant of the community; and not be converted merely into means whereby the few may amass wealth. The community, represented by the workers who form the great majority of the community, always objects when the primary purpose of industry is forgotten, viz.:—the provision of means for living as healthily as possible.

A modern nation is made up of those engaged in its trades and industries; but trade after trade is accustomed to claim that the economic position of the moment is such that this purpose is difficult, if not impossible, of attainment if adequate profits are to be made. Yet unless traders and industries place first the purpose of their existence, and not the prizes, the nation as a whole fails to be served by its industries, and becomes either an unwilling slave dragging at the chafing manacles of ill-being or actively revolutionary. Modern industry wrought by progress on the anvil of utility is a tool intended for welfare; and the first duty each industry owes to the community is to provide for those whom it employs conditions of life as good as modern knowledge can ensure.

Few, if any, familiar with the conditions of modern industrial life will maintain that this duty has been placed first and before the requirements of the process and the machine. Where the machine has required space, the worker has shared it: where the process

has required light, the worker has been allowed it; where dust spoilt the product, the worker has breathed a clean atmosphere; but the provision of space, light or clean air for the worker, as a delicate living organism, has not been a first consideration, and he has been expected to live where less delicate vegetable life would decline to exist. The first object has rather been to obtain output by some means or other; the second to make such minimum provision as would permit workers to carry on; and, if the establishment has been conducted on behalf of shareholders, the entire end has been to pay profits and dividends to some limited liability company of which it may justly be said " it has no body to beat, no soul to save, only a mouth to fill." The labour market has been full and the places of those who dropped out have easily been filled. An industrial establishment has been envisaged as a means for acquiring wealth for the few, often through the manufacture of luxuries to meet the demand of fleeting fancies, rather than a place where many spend their lives in useful production. As Burke wrote* when discussing the monks:

> "They are as usefully employed as if they worked from dawn to dark in the innumerable, servile, degrading, unseemly, unmanly, and often most unwholesome and pestiferous occupations, to which by the social economy so many wretches are *inevitably doomed.* If it were not generally pernicious to disturb the natural course *of things, and to* impede, in any degree, the great wheel of circulation, which is turned by the strangely directed labour

* Reflections on the Revolution in France. Selected works of Burke, Vol. 2, p. 190, Clarendon Press.

> of these unhappy people, I should be infinitely more inclined to rescue them from their miserable industry, than violently to disturb the tranquil repose of monastic quietude. Humanity, and perhaps policy, might better justify me in the one rather than in the other. It is a subject on which I have often reflected, and never reflected without fleeing from it. I am sure that no consideration, except the necessity of submitting to the yoke of luxury, and the despotism of fancy, who in their own imperious way distribute the surplus product of the soil, can justify the toleration of such trades and employments in a well-regulated state."

To-day, however, the discovery has been made that, if the matter is only looked at from the material point of view of profit and loss, healthy and contented workers give a better return for wages paid than can be got by the most careful attention to shafting and lubrication; this is comparatively a new discovery.

The introduction of power-driven machinery was a shock to the system of industry built up as it was on countless generations of manual labour; and, while the shock was fresh and intense, while the possibilities of this new thing were being investigated and examined, while the inanimate machine was being discovered and developed, much may be forgiven. That time is now by; machinery will be further developed, but its value is known; industry has studied the machine and must now turn to her neglected children. The present era, when compared with the past 150 years will undoubtedly be marked for the discovery and study of the power and capacity of the living worker; and just as in the past every industrial establishment

has maintained its engineering department, so in the future it will maintain its human department. For in very truth the worker is greater than his machine. It is to this human department that the name of " Welfare " has been attached ; some dislike the name and prefer to call it the "employment " or "labour " department, but the exact term used is unimportant so long as what it stands for is understood.

This department is required to study the workers individually and severally as living, thinking beings ; and the end it has to attain is (i.) to obtain a healthy and contented personnel, and (ii.) to maintain it in health and contentment. This end should be attained primarily that the industry may justify its existence to the community, and secondly that it may receive good and efficient service from those it serves. In this way some action would be taken to deal with one reason "their lives should be so long and their wages so small, their lives so dull and colourless, and their opportunities of reasonable rest and recreation so few " ; and thus the British workman may be able to live a life worthy of his great citizenship, and be enabled to give of his best to maintain for the nation in peace the position he has won for it in the War.

THE STATUS OF A WELFARE AND HEALTH DEPARTMENT.

While the establishment of a Welfare Department is strongly urged as a necessary development of modern industry, it is as strongly urged that this step should not be taken unless whole-heartedly. The manager must be prepared to give the new department, however small a beginning is made, full status on his staff with

direct access to himself; anything less is to court failure. If he is content to appoint some one or other with no definite authority to do something indefinite who without reference to himself can be overruled by foremen or assistant engineers, he will rue the day he dabbled in welfare. He must recognise welfare as an important factor, and treat it as such; as a bridegroom treats his bride; as something delightfully necessary to life that has come to stay; with definite duties and responsibilities concerning which he is not competent to judge, but is required from time to time to support with his authority. He must be prepared to give honour and assistance if he expects to receive invaluable help and allegiance; otherwise he had better remember "Punch's" advice to those about to marry.

He may decide while the new department is finding its feet, to entrust to it only part of the duties he intends shall finally be undertaken; but at each stage as he gives duties he must give sufficient authority. As he passes on into expert hands responsibilities he has no time, and possibly no aptitude for undertaking, the weight on his shoulders should lighten agreeably; but he will only add to his worries if he attempts to delegate responsibility without the power to carry it.

The Personnel of a Welfare and Health Department.

Workers are human beings with a psychological as well as a physiological side; and they must not be provided for as though they were so many animals (although the provision made for, and care taken of domestic animals, such as pedigree stock, race-horses and pet dogs is often far in advance of what in some

factories is thought necessary for workers). The new department must take cognisance of both sides; but as the sides overlap, they cannot be dissociated in the personnel. Social workers are required on the psychological side, and medical workers on the physiological; but the social workers should have knowledge of the rudiments of physiology and sanitation; and the medical of social science. Generally the social side is entrusted to officers known as welfare supervisors, welfare superintendents, labour superintendents, or, in the case of boys, apprentice masters; and the physiological side to medical officers, trained nurses, dentists, and canteen superintendents. A factory employing some thousands of workers, composed of adults and juveniles, males and females, requires on the staff of its welfare department :—

1. *Welfare supervisors for women and girls.** *The following scale may be a guide* :—

up to 300 workers, one welfare supervisor.
a further 300 workers, one assistant ditto;
a further 450 workers, a second ditto, ditto;
a further 600 workers, a third ditto, ditto;

Total 1,650 women and girls, one senior welfare supervisor and 3 assistants. After this number one assistant should be added for every 600 workers.

2. *Welfare supervisors or apprentice masters for boys*:

up to 100 boys, one welfare supervisor;
a further 200 boys, one assistant ditto;
a further 350 boys, a second ditto, ditto;
a further 500 boys, a third ditto, ditto.,

Total 1,150 boys; one senior welfare supervisor

* The scales given are only intended as practical suggestions and not as rigid rules.

and 3 assistants. After this number one assistant should be added for every 500 boys.

3. *Welfare Supervisors for men.* These officers are usually combined with those acting for boys; and in such cases the scale suggested in the case of women and girls may be taken as a guide. Examples of officers acting for men only are not yet sufficiently numerous to base a scale upon.

4. *A Medical Officer*, preferably acting whole-time; and, if the great majority of the workers are female, preferably a woman; but great value can be obtained from the part-time service of a local practitioner as will be pointed out later.

5. *Trained Nurses in charge of the ambulance station.* The number required will vary with the frequency of minor injuries which is greater in some industries, such as engineering and woodwork, than in others, such as weaving and clothing. Where there are separate ambulance rooms for males and females, there should be a nurse in charge of each; and, where night work is carried on, a separate nursing staff is required for the night shift. Probably one or other nurse, as the number of males or of females predominates, will require an assistant.

6. *A dentist* who should attend during working hours on one or more days each week.

7. *A Canteen Superintendent* who will of course have his own staff of cooks and attendants. He should be recognised as an officer of the Welfare Department.

WELFARE COMMITTEE.

An important part of welfare organisation is a committee of the workers elected by themselves; it

should be representative of all classes of labour employed, male and female, and of each shop; and should meet periodically under the chairmanship of the welfare supervisor. Such a committee may conveniently be called into existence to assist in the selection of a welfare supervisor, medical officer, or canteen superintendent; three or four suitable persons selected from candidates for the post may be submitted to the committee from whom to make the final selection. In this way the sympathies of the workers are engaged from the beginning, a matter of the utmost importance; for no welfare scheme can be a success which does not receive the support and co-operation of those for whom it exists. Other branches of works management are intended in the first place to benefit the business carried on, and the workers only benefit through their success; welfare on the other hand is intended first to benefit the workers, while the business only benefits indirectly through them. For this reason the workers should be called in to assist in the direction of any welfare scheme. Through such a committee an ambulance corps and shop committees for accident prevention can be organised; a sickness and emergency fund raised and administered; entertainment and sports committees appointed; canteen complaints can be discussed and remedied. The welfare supervisor can refer to it difficult cases trenching on trade union prerogatives; and should have the power of vetoing discussion on any matter which the manager considers outside the functions of the committee. Grievances of the most diverse kind, real and imaginary, can be settled by it. Indeed a strong welfare committee is invaluable.

Even juveniles can be organised to assist. At one factory this has been effected in a novel way by forming a parliament to which every twenty-five juveniles elect a member; these members in their turn elect a cabinet of ministers. (The prime minister might be a member of the main welfare committee). The parliament is re-elected somewhat frequently, namely every quarter; and parliamentary procedure is adopted at meetings. Several useful proposals have been obtained in this way. At first such a parliament might require the welfare supervisor to act as speaker.

DUTIES OF WELFARE AND HEALTH STAFF.

The scope of the activities of a Welfare Department is of paramount importance and should be defined as accurately as possible. At the start advantage may be gained by restricting action to matters which have previously been left unattended to; thus friction may be avoided arising out of the innate conservatism of those accustomed to carry on in their own old way and suspicious of any innovation. Later as the department settles down and becomes accepted the field of action can be enlarged. The manager must decide for himself the start to be made and the moment for enlargement. During the War the Welfare and Health Department of the Ministry of Munitions thought it advisable to issue suggestions relating to the work of Welfare Supervisors as a guide to employers; and, as these remain of value, they are reproduced here.*

* The following publications should also be consulted:—
(i.) Welfare Supervision. Memo. No. 2. Health of Munition Workers' Committee. Government Printing Office.
(ii.) Handbook for Apprentice Masters. Ministry of Labour. Government Printing Office.

MINISTRY OF MUNITIONS.

Duties of Welfare Supervisors for Women.
(Sometimes called Employment Superintendents).

NOTE.—It is not suggested that all these duties should be imposed upon the Employment Superintendent directly she is appointed. The size of the Factory will to a certain extent determine the scope of her work, and in assigning her duties regard will of course be had to her professional ability to cope with them.

The experience which has now been obtained in National and other Factories making munitions of war has demonstrated that the post of Welfare Supervisor is a valuable asset to Factory management wherever women are employed. Through this channel attention has been drawn to conditions of work, previously unnoted, which were inimical to the well-being of those employed. The following notes have, therefore, been prepared for the information of employers who have not hitherto engaged such officers, but who desire to know the position a Welfare Supervisor should take and the duties and authority which, it is suggested, might be delegated to her.

POSITION.

It has generally been found convenient that the Welfare Supervisor should be directly responsible to the General Manager, and should be given a definite position on the managerial staff in connection with the

Labour Employment Department of the Factory. She is thus able to refer all matters calling for attention direct to the General Manager, and may be regarded by him as a liaison between him and the various Departments dealing with the women employees.

Duties.

The duty of a Welfare Supervisor is to obtain and to maintain a healthy staff of workers and to help in maintaining satisfactory conditions for the work.

In order to obtain both a satisfactory staff from the point of view of health and technical efficiency, it has been found to be an advantage to bring the Welfare Supervisor into the business of selecting women and girls for employment.

I. The Obtaining of a Healthy Staff.

Her function is to consider the general health, physical capacity and character of each applicant. As regards those under 16 years of age, she could obtain useful advice as to health from the Certifying Surgeon when he grants Certificates of fitness. The Management can, if they think fit, empower her to refer for medical advice to their panel Doctor other applicants concerning whose general fitness she is in doubt. The selection of employees furnishes the Welfare Supervisor with a valuable opportunity for establishing a personal link with the workers.

Her function is thus concerned with selection on general grounds, while the actual engaging of those selected may be carried out by the Overlooker or other person responsible for the technical side of the work.

In this way both aspects of appointment receive full consideration.

The Management may find further that it is useful to consult the Welfare Supervisor as to promotions of women in the Factory, thus continuing the principle of regarding not only technical efficiency but also general considerations in the control of the women in the Factory.

II. The Maintaining of a Healthy Staff.

The Welfare Supervisor should ascertain what are the particular needs of the workers. These needs will then be found to group themselves under two headings :—

(*a*) Needs within the Factory—Intramural Welfare.

(*b*) Needs outside the Factory—Extramural Welfare.

INTRAMURAL WELFARE.

I. Supervision of Working Conditions.

The Welfare Supervisor may be made responsible for the following matters :—

(*a*) *General behaviour of women and girls inside the factory.*—While responsibility for the technical side of the work must rest with the Technical Staff, the Welfare Supervisor should be responsible for all questions of general behaviour.

(*b*) *Transfer.*—The Welfare Supervisor would, if the health of a woman was affected by the particular process on which she is engaged, be allowed, after having consulted the Foreman concerned, to suggest to the Management the possibility of transfer of the woman to work more suited to the state of health.

(*c*) *Night Supervision.* — The Welfare Supervisor should have a deputy for night work and should herself occasionally visit the Factory at night to see that satisfactory conditions are maintained.

(*d*) *Dismissal.*—It will be in keeping with the general suggestions as to the functions of the Welfare Supervisor if she is consulted on general grounds with regard to the dismissal of women and girls.

(*e*) *The maintenance of healthy conditions.*—This implies that she should, from the point of view of the health of the female employees, see to the general cleanliness, ventilation and warmth of the Factory and keep the Management informed of the results of her observations.

(*f*) *The provision of seats.*—She should study working conditions so as to be able to bring to the notice of the Management the necessity for the provision of seats where these are possible.

II. Canteen.

Unless the Factory is a small one it would hardly be possible for the Welfare Supervisor to manage the canteen. The Management will probably prefer to entrust the matter to an expert who should satisfy the Management in consultation with the Welfare Supervisor on the following matters :—

(1) That the Canteen provides all the necessary facilities for the women workers; that is to say, suitable food, rapidly and punctually served.

(2) That Canteen facilities are provided when necessary for the women before they begin work so that no one need start work without having taken food.

(3) That the Canteen is as restful and as comfortable

as possible so that it serves a double purpose of providing rest as well as food.

III. Supervision of Ambulance Rest Room and First Aid.

While not responsible for actually attending to accidents, except in small Factories, the Welfare Supervisor should work in close touch with the Factory Doctor and Nurses. She should, however, be responsible for the following matters :—

(1) She should help in the selection of nurses, who should be recognised as belonging to the Welfare staff.

(2) While not interfering with the Nurses in the professional discharge of their duties, she should see that their work is carried out promptly and that the workers are not kept waiting long before they receive attention.

(3) She should supervise the keeping of all records of accident and illness in the Ambulance Room.

(4) She should keep in touch with all cases of serious accident or illness.

It would further be useful if she were allowed to be kept in touch with the Compensation Department inside the Factory with a view to advising on any cases of hardship that may arise.

IV. Supervision of Cloak-rooms and Sanitary Conveniences.

The Welfare Supervisor should be held responsible for the following matters :—

(1) General cleanliness.
(2) Prevention of Loitering.
(3) Prevention of Pilfering.

The Management will decide what staff is necessary to assist her, and it should be her duty to report to the Management on these matters.

V. Provision of Overalls.

The Welfare Supervisor should have the duty of supervising the Protective Clothing supplied to the women for their work.

EXTRAMURAL WELFARE.

The Welfare Supervisor should keep in touch with all outside agencies responsible for :—

(1) Housing.
(2) Transit facilities.
(3) Sickness and Maternity cases.
(4) Recreation.
(5) Day Nurseries.

In communicating with any of these agencies it will no doubt be preferable that she should do so through the Management.

III. Records.

A. The Welfare Supervisor should for the purpose of her work have some personal records of every woman employee. A card-index system is recommended.

B. The Welfare Supervisor should have some way of observing the health in relation to the efficiency of the workers, and if the Management approved this could be done :

(*a*) By allowing her to keep in touch with the Wages department. She could then watch the rise and fall of wages earned bv individual employees

from the point of view that a steady fall in earnings may be the first indication of an impending breakdown in health.

(*b*) By allowing her to keep in touch with the Time Office she should be able to obtain records of all reasons for lost time. From such records information can be obtained of sickness, inadequate transit and urgent domestic duties, which might otherwise not be discovered.

(*c*) By keeping records of all cases of accident and sickness occurring in the Factory.

MINISTRY OF MUNITIONS.

Scheme of Welfare Supervision for Boys.

The suggestions contained in this memorandum are founded on the experience of employers who have in actual operation the whole or part of the scheme. Nothing is suggested that has not been proved to be successful in its results.

The essence of the scheme lies in placing on some member of the staff the responsibility for the general well-being of the boys.

In large firms there is enough work to occupy the whole time of an officer.

In smaller firms various alternatives have been adopted :—

(1) The services of an officer are shared by two or more firms.

(2) An officer already on the staff is given special duties as regards the boys.

(3) An officer is specially appointed, but has placed on him other duties in addition to those connected with the supervision of the boys.

Duties.

Among the duties performed by such an officer the following are the more important of those usually placed upon him :—

Engagement.

(1) He will keep in touch with the Employment Exchanges and the Special Advisory Committees frequently attached to such Exchanges. In this way he will secure valuable information relating to the health and school career of the boy.

(2) He will interview boys and parents, explain to them the nature of the work and the importance of good timekeeping, and will take up references.

(3) He will arrange for suitable boys to be brought before the Heads of Departments who will decide whether the boys shall be engaged. In some cases the actual engagement is left to him.

(4) He will see that an Engagement Form is filled up ; and, in the case of indentured apprentices, carry through the indenture.

(5) He will, especially during the first weeks of employment, keep in close touch with the boy, and assist him in the various difficulties which confront a boy on first entering industry. He will consult with the foreman as to the suitability of the boy for the work on which he is engaged.

Progress and Discipline.

(1) He will receive reports from foremen on the boys' progress; will consider complaints, and, in the event of threatened dismissal, will see the boy before a decision is reached. (In no case have the Department discovered any evidence to show that foremen resent this procedure).

(2) He will see the boys from time to time and afford them opportunity of making complaints to him.

(3) He will send reports to parents on the boys' general progress, wages, and timekeeping; and occasionally visit their homes.

(4) He will discuss with Heads of Departments schemes of transfer, promotion and training. In the case of indentured apprentices he will see that undertakings are carried out.

Continued Education.

(1) He will consider schemes for securing attendance at Continuation Classes.

(2) He will offer inducements to secure regular attendance.

(3) He will discuss with the Education Authority :—

(*a*) The question of technical training in the cases of boys who are learning a trade.

(*b*) The question of general education of other boys.

(4) He will obtain from the head of the school reports on the boys' progress and attendance.

Health.

(1) He will endeavour to become acquainted with the information contained in the report of the School Doctor.

(2) He will be present at the medical examination of the boy at the factory, and note the doctor's recommendations.

(3) He will give special attention to ailing boys and cases of sickness, and endeavour to ascertain the cause.

(4) Where lodgings are in demand, he will keep a list of suitable lodgings.

(5) He will endeavour to secure that the boys obtain suitable food; and may be made responsible for the general supervision of the canteen and messroom, and for the arrangements for heating carried food.

(6) He will be responsible for seeing that boys obtain First Aid in case of accident; and may be entrusted with the duty of supervising the First Aid equipment.

(7) He will encourage boys to use overalls; will see that the washing and sanitary arrangements are adequate and in good condition, and will supervise order and decency in their use.

Thrift.

He will be responsible for the initiation and carrying out of Thrift Schemes, as for example :—

(1) By the voluntary stoppage of a certain weekly sum from wages.

(2) By weekly collection.

(3) By payment of good conduct bonus to the boys' credit.

Recreation.

(1) He will be responsible for organising outdoor games; and for the management of a recreation room, if such exists.

(2) He will consider the question of forming a Cadet Corps or Scout Troop.

RECORDS.

He will keep systematic records of each boy.

MEDICAL OFFICER.

The value of medical officers is rapidly coming to be more and more recognised. The duties entrusted to them, which vary widely at different factories, may be grouped under two headings: (i.) the prevention of disease, or, as it should rather be called, the preservation of health, and (ii.) treatment of injuries and illness.

The preservation of health.—(*a*). The medical officer should examine all applicants for work before engagement; note the presence of physical defects; and advise as to any treatment required, and as to the suitability of the candidate for the employment proposed. (*b*). He should periodically (say quarterly if employed part time) inspect and report on the hygienic conditions of each workplace, as regards: ventilation; temperature; lighting, both natural (*e.g.*, cleanliness of windows), and artificial (*e.g.*, position and sufficiency of illlmination); freedom from dirt and refuse; condition of cloakrooms, lavatories and sanitary accommodation; and the wholesomeness of the food supplied in the canteen. (*c*). At those visits he should also examine the lost time and sickness records; note the general health of the workers; the existence of unhealthy postures; the prevalence of spitting; the use of suitable working clothes.

The treatment of injuries and illness.—The medical officer should visit the ambulance room daily to see cases retained for him by the nursing staff. (*a*) Illness. Here, except in so far as he may be the accepted panel doctor for some of the workers, action should be restricted to such first-aid treatment and to such minor complaints as can be dealt with at the ambulance room, and to advising workers when to consult their own medical attendant. (*b*) Injuries. Here more may reasonably be undertaken. An injury must receive immediate treatment, and advantage is gained if the line adopted is carried through. The majority of injuries can be dressed and re-dressed by the medical officer or by the nurses under his direction at the ambulance room until healed ; while unless this officer happens to be also a rival practitioner, panel doctors do not usually object to his attendance on more serious cases of injury in their own homes. Experience has shown that this plan ensures more rapid healing with a saving of pain and suffering and of much lost time.

Medical service may be arranged for in various ways from whole-time to periodical visits. At large engineering factories employing 3,000 workers or more, whole-time service is required to carry out the duties detailed above ; at such a factory, apart from examining new-comers, the medical officer would probably see some 75-80 patients a day, most of whom would otherwise to their detriment not receive medical attention. At a rather smaller factory with an efficient nursing staff, a daily visit at a definite time by a local practitioner may be sufficient. Small factories, especially if carrying on work not associated with an undue prevalence of minor injuries, such as

tailoring or dressmaking, may retain the services of a doctor to make quarterly inspections and come at such other times for examining new comers or attending cases of emergency as may be required. Remuneration for part-time service may reasonably be made by capitation based on the number employed.

Whatever decision be arrived at as to the extent to which at first medical services shall be retained, the important matter is to recognise that a Welfare Department without a medical officer is like the play of Hamlet without the Prince of Denmark; and that the value of his services to the industry soon far outweigh any salary he is given. While, however, this is so, only a few practitioners will to-day be found fully equipped with the knowledge required to fill the post of factory medical officer; and managers must be prepared to allow time for gathering knowledge through experience, and to encourage attendance at post-graduate courses where special instruction is given. Occupational medical service is to-day in its infancy; but it is bound to become one of the most important branches of the practice of medicine in the future. The influence occupation exerts upon general health is undoubted; as Sir James Paget put it "fatigue has a larger share in the promotion or permission of disease than any other single casual condition you can name." Yet to-day the doctor knows but little of the occupations of his patients, which are carried on behind factory walls or underground in mines where he never enters. How can he give sound advice? The doctor of 200 years ago was better placed so far as knowledge went of how his patients spent their

lives—for the most part at some open-air occupation or at some home industry.

The Nurse.

No part of the Welfare Movement met with more ready acceptance than the work of the factory nurse. Her advent has been synchronous with the provision of ambulance stations and rest rooms. Intended originally for the first-aid treatment of injuries, these stations are found to possess a far wider function when presided over by a capable trained nurse. Apart from dealing with burns, cuts and abrasions, eye injuries, and sprains, treatment is sought for colds, coughs, eczema, chilblains, sore throats, warts, headache, indigestion, varicose veins, venereal trouble, boils and even dog-bites. Nor are the workers the only persons who attend at the ambulance stations, for members of the clerical staff and even the manager himself may be found seeking relief. Nurse becomes the friend of all, and is the most communal institution in the factory. Her duties are (i.) to attend during working hours, including meal times; (ii.) to render first-aid to all who come; (iii.) to arrange first-aid organisation so that no injury, however apparently trivial, escapes treatment; (iv.) to inform the Welfare Department of cases requiring home visiting and help; (v.) to keep careful records of every case (a card-index system should be used with different coloured cards for surgical, medical and dental cases); (vi.) to work under the medical officer, and collaborate with outside medical service. Great advantage may be got from consulting the out-patient department of the local hospital or the panel doctors as to treatment; an

instance will indicate the method. The patient is sent with a note "I am anxious about this inflamed finger. Please advise." The house surgeon replies "The case is a whitlow which has been lanced. Fomentations every four hours, send to be seen again in four days." Long waiting in the out-patient department is thus avoided, and continuous careful supervision ensured; in many cases work may not even have to be suspended.

The work of an ambulance station may be gathered from such figures as the following: at a factory employing over 8,500 males and 2,000 females, 57,649 cases were treated in nine months; at another employing 1,100 males, 380 females and 235 boys, there were in two months 1,787 surgical and 2,143 medical attendances. The proportion of medical to surgical cases varies greatly at different factories, and was at another factory 600 medical and 1,416 surgical; but the outstanding feature is the amount of medical work which has come to light. There can be no doubt that work on this scale must go far towards oiling the human wheels of industry.

The cost entailed varies in the amount of treatment given; for instance some factories wisely allow expensive drugs such as cod liver oil and malt to be issued. Some idea can be gathered from three instances:—At one factory employing 2,500 workers, the annual expenses were about 2s. a head; at another with 1,500 workers, 4s. a head; and at a third (where the ambulance room had cost £400 to build and equip) with 900 workers, 5s. 5d. a head. The above, however, are war-time figures, and must be taken as an underestimate at present prices.

The Dentist.

The value of a dental clinic on the premises is considerable. Hospital dental departments are seldom open in the evening; and even practising dentists do not always attend their consulting rooms at times convenient to operatives. Long waits occur in either case; and the necessary visit to the dentist—never a pleasant one—is postponed indefinitely. At a works' clinic dental treatment advised by the nurse or medical officer, especially for juveniles seeking engagement, can be expeditiously carried out. The attendance of a qualified dentist for an hour or so can usually be easily obtained on one, two or more days a week as required. The necessary equipment which can be kept in the ambulance room costs about £100; and arrangements can be made for the workers to pay by instalments from wages for treatment received. In some cases the dentist is paid a retaining fee, and all extractions are free, but stopping, crowning and dentures are charged for.

The Canteen Superintendent.

Energy cannot be put forth by the human frame in the form of work unless energy has first been introduced in the form of food, any more than a motor car can be run without petrol or a locomotive without coal. Living beings differ from inanimate machines in requiring a constant supply of energy merely to maintain life even when no work is being done. When work is done this supply must be increased in proportion to the amount of work done. The function of an industrial canteen is to

ensure that at least a proportion of the daily amount of energy required is supplied in wholesome form and in cheerful surroundings; and the duty of the Superintendent is to effect this purpose economically. Different processes call for different output of energy; and the demands and tastes in food by the workers will be found to vary accordingly. The Superintendent should watch closely the tastes of the workers and meet them as far as possible. At the same time he must set his face against meals inadequate in amount and unwholesome in kind chosen for the sake of misplaced economy. The wage-earner who half starves herself on bread, pickles and tea in order to support others soon loses health, ceases to earn wages, and requires support herself. The Superintendent should watch what is going on and inform the Welfare Supervisor accordingly. He should possess a knowledge of the energy value of the various articles of food, and of the balance which should be maintained in the menu between proteids, fats and carbo-hydrates; and should understand the difference between providing an adequate dietary for manual labourers, which requires careful and constant study, and that of ordinary restaurant catering. The popularity of the canteen is the best indication of his success; and its unpopularity of his failure. High prices, required to make the accounts balance, may be adduced to explain failure; but prices within reason are seldom objected to when the food is rightly balanced, and well cooked and served. The Superintendent should always arrange the best possible service and table equipment; flowers and clean table cloths call for good manners and clean hands; dirty tables and benches with second-class

crockery are productive of horseplay, breakages and pilfering. Give the workers a canteen to be proud of, and the canteen will soon be proud of its workers.

Research Work.

The duties stated above must bring the staff of a Welfare and Health Department up against problems of which they know no solution. Let them then seek diligently for a solution; and not be content with accepting some conclusion which seems probable, for not thus has progress been made; but by a careful and painstaking enquiry. The keeping of detailed records has been recommended throughout the work; not just to inculcate business methods, but to provide material for investigations. Each member of the staff will be well advised always to have in hand some special inquiry; the causes of lost-time; the prevalence of accidents; the effects of different types of work upon (i.) the physiological functions of women; (ii.) the height and weight of juveniles, (iii.) eyesight, (iv.) hearing; a study of seats in relation to work; the spread of infectious complaints, such as colds and influenza; the occurrence of eczema; the effect of recreation on work; the occurrence of septic wounds; the extent of and reasons for labour turnover; are some among many things calling for investigation. Each enquiry entails reading what is already known on the subject, and so widens the enquirer's knowledge and outlook, and helps him to acquire more. Each enquiry completed helps on the next. A modern industrial establishment is in reality a ready-made laboratory where the human frame is subjected to experimental

conditions; and it is the function of the department to study the results; just as it is of the engineering or chemical departments to study the behaviour of machinery and the reactions of processes; and not to proceed by rule of thumb. Nothing should be taken for granted, everything should be proved; no subject is too small to look into.

> "Although the acquisition of fresh knowledge is the necessary precursor of every step in social progress, such acquisition must itself be preceded by a love of inquiry, and therefore by a spirit of doubt; because without doubt there will be no inquiry, and without inquiry there will be no knowledge. For knowledge is not an inert and passive principle, which comes to us whether we will or no; but it must be sought for before it can be won; it is the product of great labour, and therefore of great sacrifice. . . . . They who do not feel the darkness, will never look for the light."*

A department in which no inquiries are being made must soon become retrogade and behind the times.

THE LIMITATIONS OF WELFARE AND HEALTH WORK.

The scope of work which has been sketched is wide; but, that friction may be avoided through too jealous workers stepping outside and invading the province of others, something must be laid down as to the limits of the sphere of activity. These limits are set on two sides, one by technical control, and the other by trade union work.

* History of Civilisation in England. H. T. Buckle. Vol. 1, Ch. VII.

The technical side of management upon which all industrial processes depend has certain definite duties in reference to which it must be paramount; it is, moreover, first in the field and naturally resents the intrusion of a new comer. Most welfare and health work lies clearly outside these duties. But overlapping is bound to occur; the provision of seats during work, the interpolation of rest pauses, the wearing of overalls, adequate lighting, reasonable temperature, are all instances where the technical side may object to alterations. Courtesy and wisdom suggest that in any case of doubt the new comer should give way; moreover let him remember he has yet much to learn about industry and about his own craft. The scope for work is wide enough to leave controversial matters alone until the confidence of the technical side has been won, and combined action can be taken. It is a mistake to force innovations on the unwilling who have power to ensure their failure. The golden rule to-day must be " in case of doubt defer to technical control."

Trade unions claim a certain scope of work which may be summed up as control of wages and hours of work. The beneficial effects of their activities in the past cannot be gainsaid; indeed, it may be looked upon as the very foundation of welfare work. When operatives were overworked and underpaid welfare had no place; recreation is useless to the tired and overworked; and good canteens to those with no money to buy food. The fixing of wages is no part of the duty of the new department; but it must obtain a thorough grasp of the wage system, however complicated, in vogue at the factory, so that explanations can be given to the operatives who, not infrequently,

are unable to understand it and suspect a grievance when no grievance exists. The past history of the trade union movement should be carefully studied; and all doubtful and borderland matters should be referred to the Welfare Committee or trade union representatives. But care must be exercised that the Welfare and Health Department does not become an intermediary in trade union disputes, else it will be ground to bits between the upper and nether millstones of capital and labour.

SUMMARY.

Welfare and health work is needed to lubricate the wheels of the living machinery of industry.

It must be given a status commensurate with its importance.

It requires a department of experts acting in close touch with the workers.

The duties of the department should be carefully defined, and include activities both inside and outside working hours.

Constant inquiries and investigation are a necessary part of the work.

Every effort must be made to avoid trenching on the established prerogatives of technical control and of trade unionism.

PART V.

LECTURE XI.

Industrial Research

By A. P. M. FLEMING, O.B.E., M.SC., M.I.E.E.

INDUSTRIAL development, which arises from the application of new knowledge, was in its earliest stages accomplished by the knowledge derived from the everyday experience of the workers. With each stage of development the need for further knowledge becomes more marked, and the search for this knowledge becomes increasingly exacting. In the most complex industries progress is only maintained by a systematic search for, and application of knowledge, embodying the most up-to-date advances in scientific discovery. It is the function of the research worker to provide this new knowledge.

Considerable confusion still exists as to the meaning of the terms "pure science research" and "industrial research." The difference is not one of method but of motive, arising as it does entirely through the differing aims pursued. In the conduct of pure research, the scientist aims simply at enlarging the boundaries of existing knowledge, whereas the industrial research worker always has as an objective some definite application in industry of the knowledge he seeks. The pure science research worker is always the pioneer.

He reveals and explores the hitherto unknown territory: the industrial research worker proceeds to develop the resources of the territory thus disclosed rendering them valuable through the manufacturer to the community in general. The pure scientist, the industrial research worker, and the manufacturer are all interdependent portions of a system which enables some discovery to be rendered of service to mankind.

The early researches of Faraday in electricity and magnetism laid the foundations for the whole of modern electrical engineering practice. The progressive investigations of coal-tar products have led to the supply of a whole range of previously unknown dyes, drugs, and high explosives.

While, however, the industrial research worker develops the knowledge disclosed by the pioneer in pure science, the application of his efforts is often arrested until corresponding advancement in another science removes an obstacle confronting him; for instance, the work of Langley in aeronautics, while of fundamental importance, did not make mechanical flight possible, until the development of the internal combustion engine—which enabled great power to be obtained with a minimum weight—was brought to a practical issue. On the other hand, industrial progress is often delayed until the pure scientist has, from his discoveries, disclosed the fundamental laws which unduly complex phenomena. Every new scientific discovery which finds application in industry becomes a nucleus from which radiate many new lines of investigation, each of which may terminate in other nuclei, thus indefinitely enlarging the possibilities of new industrial fields. Similarly in

the pursuit of an investigation having some definite objective, promising lines of research are often disclosed, which, if followed, may lead to discoveries of greater importance than that originally anticipated.

There is a tendency on the part of industrialists to overlook the enormous importance of research in pure science; almost every scientific discovery, sooner or later, finds some application in industry, and every encouragment should be given for the conduct of such research. Equally necessary is the industrial research without which the full economic benefit of scientific discoveries cannot be effectively obtained, and the closest possible connection must always be maintained between these two types, neither of which, it should be carefully noted, is necessarily confined to any particular institution or kind of laboratory, or grade of worker.

For several years past increasing attention has been given in this country to industrial research, and this interest has been stimulated very considerably by the war-time demand for new materials, and for the development of improved methods of production. As a result of this experience, progressive industrialists are beginning to realise that in the application of science in industry, they have the most potent method of securing efficient production, a requirement of the greatest significance in the keen international competition of the future.

CO-OPERATIVE RESEARCH.

The need for research on a scale sufficiently large to embrace the industrial activities of this country was realised about five years ago, when an Advisory

Council was set up by the Privy Council to consider the question. As a result of its work, the present Department of Scientific and Industrial Research was formed, which has been provided by the Treasury with considerable funds for the encouragement and assistance of research in industry.

The principal channels through which this assistance is rendered are those provided by Research Associations, which have been set up in various industries by firms engaged therein for the purpose of conducting investigations of common interest to all subscribing firms, the cost of these investigations being borne for a period of five years equally by these firms and by the Department of Industrial Research.

Already, Research Associations have been formed in several of the leading industries, and it is expected ultimately that all of importance will be included in the scheme.

In other directions assistance has been provided by the Treasury on behalf of the Department of Scientific and Industrial Research to recognised individuals who are in a position to conduct special researches of value to industry, also to universities and scientific institutions. One of the most important features of the Department's work has been assistance given to university graduates to pursue a course of training fitting them to become research workers. Research cannot proceed unless there is an adequate supply of fully trained workers, and unfortunately in this respect there has been a very great deficiency in this country. Such men will, in the main, come from the universities, and it is necessary to give every encouragement to suitable students to follow the career of an

industrial research worker. It is equally important for industrialists to realise the value of such men, and to make their careers attractive, both financially and otherwise.

As already pointed out, the manufacturer is simply one portion of the system which renders some resource of Nature of benefit to the community. Any means, therefore, which will disclose new resources, or enable the manufacturer to render them of use in industry, is of direct value to the public generally whose welfare essentially rests on industrial prosperity and whose opinion will provide the driving force towards further advance.

This view must be kept before the public so that there shall be no stint in applying public funds to the encouragement of research, and especially in connection with the training of research workers. As regards manufacturers, a much broader view must be adopted towards research than has hitherto been held. It must be appreciated that progress depends increasingly upon the use of new scientific knowledge, and that money must be expended in its pursuit.

Further, it must be realised that with the need for capturing the export markets, increasing competition will be felt from industrialists of competing nations, who are preparing themselves by every possible means to secure supremacy. The effectiveness of research depends to a considerable extent upon the scale on which it is conducted, and to secure the maximum benefits, firms who are otherwise competitors should pool their resources where this will lead to an improvement in productive methods that are common to their particular industry. In this way the hampering effects

of secrecy in connection with manufacturing methods will disappear.

RESEARCH AS A FUNCTION OF INDUSTRIAL MANAGEMENT.

The conditions of industry are continually changing. At present there is a tendency for the cost of labour to increase considerably, due to higher wages and shorter hours. When this condition is coupled with the national need for increased production, it at once becomes evident that the problem confronting the industrial manager is to improve in every way possible the efficiency of his manufacturing methods. The solution of these and other problems can only be satisfactorily solved by means of research, and it therefore becomes of the utmost importance to management to consider in what way this means can be most effectively employed.

No process or method of manufacture ever reaches finality, and in a case where processes are common to a number of manufacturers in the same industry, investigations relating to their improvement can most effectively and economically be conducted jointly through the medium, for instance, of a research association. It may be noted that by pooling the knowledge thus obtained, each firm is still able to compete with its fellows as before, and is most readily able to compete with the foreign manufacturer by virtue of the improvement in its methods. Almost every industrial concern, however, has some problems peculiar to itself, which perhaps cannot readily be dealt with through a research association. Where a

firm is small it may not be able for financial reasons to set up its own research laboratory, and in this case the facilities provided by universities or national research laboratories must be employed. On the other hand, where a works is of considerable size, it will inevitably pay to establish a separate research organisation, although in addition it will, in all probability, be able to make effective use of research associations and also of university, national and other research laboratories, where these possess equipment or staff specially suited to particular investigations.

There is an increasing tendency for combines to be formed comprising a number of works either in the same industry or in allied industries. In this case the research organisation found most effective will comprise laboratories in each works designed to deal with immediate local investigations, and a central laboratory for handling the researches common to all the works, and the more advanced pioneer investigations.

Another means by which industrial research may be conducted is through the medium of an institution such as the Mellon Institute of Industrial Research, Pittsburgh, Pa., U.S.A., which is referred to in greater detail below.

Functions of a Research Organisation.

It is sometimes thought that research is invariably a matter associated with test tubes, balances, and chemical apparatus generally. While this is to a limited extent true of research in pure science, it is far from being the case with industrial research. In the search for efficiency in production, one of the most important

problems is that presented by the human factor, and the industrial research organisation of the future will not be complete unless it embraces means for the careful study of the physiological and psychological characteristics of workers. The researches of Taylor, Gilbreth, and others in the United States of America, have disclosed the possibilities of considerable increase in the efficiency of human effort through the elimination of waste motion by the analysis of all movements; the adoption of mechanical aids to production; the study of the natural rhythm or period of working so as to ensure that the frequency and length of rest periods are most effective; and by the study of conditions relating to lighting, heating, ventilation, food and recreation of workers. Apart from investigations which lead to the improvement of individual working conditions, the importance of a study of all those factors which underlie co-operation and harmonious working between management and labour and upon which the overall efficiency of industry depends, needs no emphasis. The other more usual requirements of a research organisation are those relating to the development of new tools, processes, and methods; the elimination of difficulties arising from time to time in manufacturing operations; the data required for new designs; the establishment of means for recovery of by-products, the utilisation of waste, and similar economic considerations. Further, a continuous check is necessary on the quality of raw material supplied, and the establishment of standards of quality which will enable purchase to be made, as far as possible, in the open market.

While the importance of pure science investigations

must not be overlooked, in general these will be conducted in universities or national research institutions, since the knowledge thus acquired will as a rule involve too great an expenditure of time and money to make it a commercial proposition for manufacturers to consider, as compared with those investigations which have a direct commercial objective. On the other hand in every works research organisation some latitude should be allowed to workers in the conduct of purely scientific investigations in order to stimulate and maintain their interest in this form of research.

In a works in which a research organisation is established for the first time, it will usually be found expedient for it to include work of a routine character relating to testing of materials and the supervision of technical processes, so that the necessary close contact between the research and other works departments may be preserved. With the development of the organisation the time will come when the research work proper can be segregated from that of a routine character, although the latter would always provide many of the most pressing research problems.

Relation of Research Organisation to other Functions of Management.

In addition to research, in most industries the other functions of management comprise in general, the *design* of apparatus or products, which sometimes, as for instance engineering, requires scientific knowledge of the highest order; a *commercial* organisation for the sale of the product, which again may demand a considerable amount of scientific knowledge, according to the product to be sold; and the *works administration*

department responsible for the direction of labour and the control of various processes of production. In addition there is the organisation relating to the training and welfare of workers. A research organisation is organically related to these various functions of management.

The research department should supply the designer with all the new knowledge he requires relating to the improvement of existing apparatus, or to the development of products to meet new market demands. Further, the department should, through its Intelligence Section, undertake to supply any new data forthcoming from other research investigations carried on in this or other industrial countries, which may be of assistance to him in his work.

As regards the commercial organisation, industrial research forms a most potent means of advertisement, since if a firm is known to undertake its problems scientifically, a considerable degree of confidence is inspired in the minds of purchasers. Then again, clients often have problems confronting them which it is politic for the commercial department, through the research organisation, to assist in solving. Further, the commercial department through its contact with market requirements, and the possible, hitherto unsatisfied, needs of purchasers, can often advise the research organisation along what lines to direct attention in the pursuit of knowledge required in the development of new apparatus.

The closest possible contact, however, is that required between the research organisation and the works administrative staff. It is by the staff that the bulk of the fruits of research will be used.

In every works, some difficulties will always occur, however perfect the organisation may be. These may be dealt with either by effecting a temporary remedy or by applying a palliative, or by investigating the underlying cause of the trouble and eradicating it. This latter is a function of the research organisation. The ever changing requirements of industry demand a continual watchfulness for improved methods of production, and increasingly science is finding a field for industrial application. Such work falls outside the scope of the manual worker and of the works administrator; it demands the special training and experience of a scientific investigator.

With every application of science in industry a greater need is felt in the training of manual workers to an appreciation of scientific method as compared with rule of thumb practice. Hence, there must be close connection between the research organisation and the department responsible for the selection and training of workers. In the training of staff workers, it is desirable that some time be spent by the most promising men who are ultimately destined for the research, commercial or administrative sections, in the research laboratories, so as to give them a thorough appreciation of the possible applications of science in industry, and at the same time to test their capacity for differentiating between cause and effect, a characteristic of fundamental importance for the successful man in any vocation of life.

ORGANISATION AND ADMINISTRATION.

The type of research organisation developed will depend largely on the character of the industry, and

amount of investigation to be carried out. Generally, however, it will comprise a number of divisions, the nature of which will depend on the specific character of research to be undertaken, such as chemical, metallurgical, mechanical, electrical, etc., some of which will be common to the requirements of almost any industry. In addition, there will be a library, and means for the collection and dissemination of information that may be of assistance to research workers, together with suitable workshop facilities for the production of special apparatus required for experimental purposes. An important purpose of the organisation will be to remove all experimental work from the manufacturing departments. These latter should be quite free from the hampering effects which always result from miscellaneous experimental work that is always liable to be undertaken in them. In the case of engineering, however, it may happen that for large scale investigations the works equipment may occasionally have to be used.

The extent of the subdivision of the research organisation into separate departments will necessarily be governed by conditions in different works, and no hard and fast rule can be laid down.

The organisation would be administered by a Director, who, in the case of a departmentalised organisation, will have a chief, assisted by suitable staff, in each section. Problems requiring the consideration of more than one section, would be dealt with by a suitable sub-division of responsibilities and continual conference between these sections concerned. An alternative method of administration is to have a number of experts capable of dealing with a wide range

of problems, and with suitable assistance, to allow each investigator to carry to a conclusion any particular problem. In a large organisation a combination of these two methods is usual.

STAFF.

This country has excelled for generations in the possession of scientists of the highest standing. It has been less fortunate, however, in possessing in sufficient numbers scientifically trained men who have had capacity for turning the results of the work of the pure scientist to industrial use. Through the efforts of the Department of Scientific and Industrial Research, supported by university authorities, means are being taken to remedy this shortage, which will encourage young men of suitable ability to take up the career of research worker, and while industry has thus far not held out much inducement to such men, there is reason to believe that this state of affairs will be remedied in the near future.

The research worker in industry requires a thoroughly sound scientific training, coupled with manufacturing experience. To some extent, he must be capable of working in a team by close co-operation with other workers, not necessarily of the same scientific standing, this being one of the chief points of difference from the pure science worker. It is not essential that such men be brilliant scientists, but they must have a keen appreciation of cause and effect, keen observation, and resource. After completing the university course, they should preferably spend at least a year in works, familiarising themselves with industrial requirements,

and also acquiring experience in dealing with the types of men met with in industry.

Types of Laboratories.

In the majority of cases, laboratories will need to be situated close to the manufacturing departments of the works, although where one laboratory serves as a scientific focus for a number of works, it may be advantageous to have it situated at some distance from all the works.

In determining the size of the laboratory, attention should be given to the possibility of extension. The experience in some laboratories has been that the work has doubled itself about every four or five years, hence the need for ensuring that the type of building lends itself to extension, and that there is suitable ground area available. From the divisions of the laboratory and the amount of work to be undertaken, the approximate number of men required can be estimated. It is a safe rule to allow an average of about 250 square feet of working space per worker. In addition, about 50% must be added to the total to cover the space occupied by corridors, containing walls, partitions, stores, etc.

Having determined approximately the total working area required, the type of structure has to be considered. Where this does not exceed about 6,000 square feet, it can conveniently be arranged under one roof in one storey, and a width of span of about 30 feet is an economical one. Where a large floor area has to be dealt with and land is expensive, multi-storey buildings become essential. Where, however, the land is cheap and there is plenty available, it is convenient to set up

as many single-storey buildings as may be required. Such buildings should be separated from each other, and arranged so as to enable extensions to be added as required.

For multi-floor buildings, reinforced concrete forms a suitable fabric, whereas for single-floor buildings brick-work is cheaper.

In designing the fabric, special attention is required to guard against vibration, which may be caused by machinery and transmitted from one part of the building to another, or may arise from some external source. In the former case, attention must be directed to the isolation, as far as possible, of the source of vibration, and in any case anti-vibration supports may be required for delicate instruments, fixed to supporting piers on foundations separate from those of the building.

Where multi-floor buildings are used, it is convenient to have all supplies such as water, gas, compressed air, electricity, etc., carried through large ducts feeding each floor separately. These should be large enough to admit workmen for repairs and alterations. In single-storey buildings, these supplies should be carried through suitable floor ducts.

Lighting must be carefully considered on account of the close and accurate observation that is necessary. As far as natural lighting is concerned, both top and side lighting should be provided where possible, and top lights should face the north.

Furniture, equipment, and internal finish of the laboratories will depend to a considerable extent on the character of the work, the individual taste and the money available. Special attention, however, is needed

in the design of certain portions of the chemical laboratory, such as fume chambers and benches. In the former, every possible means should be taken to ensure efficient extraction of fumes, a feature not always successfully dealt with in existing laboratories. As regards laboratory benches, the type used for instructional purposes in college and university laboratories has been adopted to a considerable extent in commercial laboratories. A much better plan, however is to use as far as possible open-type benches approximating to tables, with very little locker space, and open underneath. Such benches are much more easy to keep clean and free from dust accumulation, and are less liable to fire risk.

Table I. below indicates the relative cost of buildings, employing different materials. Table II. gives the cost of buildings, equipment, and maintenance for different sizes of laboratories on a pre-war basis. The actual pre-war cost in pounds for each of the sizes and types of building given in Table I. may be obtained by multiplying the figure given in the table by the floor area and then by 7.4, and dividing the product by 1,000. Thus a 6,000 square feet building of Class I. would cost approximately $6 \times 7.4 \times 100 = £4,440$. Table II. refers to buildings of Class 4 in Table I.

Industrial Research Abroad.

That the above expenditure is not abnormal or excessive may be illustrated by the manner in which industrial research is being pursued by our great commercial rivals, especially the United States and Germany.

TABLE I.

Class.	Description of Building.	6,000 sq. ft. single-storey.	12,000 sq. ft. single-storey.	12,000 sq. ft. two-storey.	52,000 sq. ft. four-storey.
1	Brick and steel frame with stone dressings and architectural finish	100	96	92	88
2	Reinforced concrete, with stone dressings and architectural finish	99	94	87	83
3	Brick and steel frame, plain finish ..	92	88	83	77
4	Reinforced concrete, plain finish ..	90	86	78	74

TABLE II.

COST OF:	6,000 sq. ft. single-storey.	12,000 sq. ft. single-storey.	12,000 sq. ft. two-storey.	52,000 sq. ft. four-storey.
	£	£	£	£
Building	4,000	7,640	6,930	28,500
Furniture	1,050	2,100	2,100	9,100
Apparatus	3,900	7,800	7,800	33,800
Total Capital Outlay, excluding land	8,950	17,540	16,830	71,400
Total Annual Maintenance including salaries ..	8,700	17,400	17,400	75,500

In the United States, apart from the important work undertaken by the universities, particularly those to which experimental stations are attached, and national laboratories such as the Bureau of Mines, Bureau of

Standards and the Bureau of Agriculture, and such well-known and well-endowed institutions as the Smithsonian and Carnegie Institutions, a large number of research laboratories exist associated with industrial corporations of all kinds. Some of these latter laboratories exist exclusively for research, others combine research and routine testing in one organisation but the need for extension and development through research is generally recognised.

In some cases also extensive buildings have been erected for private consulting work, such as the laboratory of A. D. Little Inc., one of the finest and most modern in the United States, comprising a three-storey basement building of a very dignified design, which in addition to the usual laboratory facilities for testing, contains plant for research in paper-making and other processes on a manufacturing scale. Among the railway companies the Pennsylvania Railroad Company holds a high position. In its testing and research laboratory, a four-storey basement building, 360 people are employed. The building and equipment cost £60,000 and a special locomotive testing plant a further £40,000. The annual maintenance cost of the laboratory is not less than £100,000.

Of the manufacturing corporations the researches of the General Electric Company and the Westinghouse Electric and Manufacturing Company are best known. The research building of the former company at Schenectady is a seven-storey building, five floors of which are exclusively devoted to research work, employing about 150 people and having an annual maintenance cost of £80,000 to £100,000. Among other advances this laboratory has been responsible

for the gas-filled lamp, drawn tungsten wire, the Coolidge X-Ray Tube, and the Langmuir pump. The Westinghouse Electric and Manufacturing Company has a number of laboratories in different parts of its various works, such as the laboratories for moulded insulation and for very fine electrical measurements. Recently its research work proper has been segregated in a building some distance from the works, the approximate cost of the equipment of which is £30,000, and the total annual expenditure on research is £70,000 to £80,000. This Company has directed special attention to research on large electrical machines, which has frequently to be carried on in the works in order to make use of the works power plant.

The American Rolling Mill Company which again has a high reputation for special products, spends £10,000 per annum on research, the three-storey building employed together with its equipment costing £9,000. The laboratory of the Eastman Kodak Company at Rochester cost £30,000, the total annual maintenance cost being about the same figure. A feature of this laboratory is a plant for producing photographic plates on a manufacturing scale at the rate of 3,000 per day.

The United States enjoys a high reputation for incandescent lamp manufacture. The research required in connection with this is chiefly conducted at the laboratories of the National Electric Lamp Association at Cleveland. It is possible to develop at these laboratories the whole of the machinery required for complete manufacture of electric lamps, and consequently the lamp factories are not hampered by experimental work.

In the physical laboratory problems in physics, physiology, and psychology having any bearing on the science of light are investigated, and no problem dealing with the production and utilisation of luminous energy or its reaction on the human organism is considered outside its scope.

The great technical development of the arts of telegraphy and telephony in America has been accomplished by the joint efforts of the American Telephone and Telegraph Company and the Western Electric Company

No description of even the salient features of industrial research in America would be complete without reference to the Mellon Institute of Industrial Research, associated with the University of Pittsburgh. The Institute is based on the industrial fellowship system developed by the late Professor R. K. Duncan, to further which the Mellon Brothers, bankers, of Pittsburgh, endowed the existing building, the cost of which was £50,000, the equipment representing an extra £16,000. The annual maintenance cost is £30,000. The manufacturer who requires to make use of the Institute for the purpose of investigating some problem in which he is interested, arranges for the Director to select one or more men, generally qualified university graduates, to conduct the work. The salary of the men engaged and the charges for special apparatus are borne by the manufacturer, but the Institute supplies the accommodation and ordinary laboratory services together with the skilled advice and supervision of the permanent staff. The manufacturer therefore virtually endows a fellowship of research at the Institute, and it is important to note that in many cases investigators have been taken

on by the manufacturer to the staff of his works at the conclusion of the investigations. The Institute will accommodate about 70 workers. Publication of results is deferred until three years after completion, if required by the manufacturer, and if he can show that publication at that time is inimical to his interests, it may be deferred for a still longer period.

One of the most recent developments is the establishment at Pittsburgh of an experimental Rolling Mill and Bureau of Rolling Mill Research, organised by the leading steel manufacturers under the auspices of the Carnegie Institute of Technology. This marks a new stage in the development of co-operative research in America and will be watched with very close interest.

Apart from these efforts, in many industries research work is undertaken by the Manufacturers' Associations. The most interesting case of this kind is that of the National Canners' Association. The research laboratory is a building rented in Washington, and although supported by the Association for its own benefit, the results obtained are communicated to all packers, as it is considered that bad packing by one firm injures the whole trade.

The action of the British Government in founding the Department of Scientific and Industrial Research has not been without influence on our competitors, and the example has been also widely followed in the overseas dominions. Advisory Boards for Science and Industry have been created in South Africa, Canada and Australia, and New Zealand is likely to take the same step.

In the United States, where in spite of the amount

of research done, very little was co-operative in character, the National Research Council was formed in 1916 through the activity of the National Academy of Sciences, and comprises the chiefs of the technical divisions of the Army and Navy, Directors of Government laboratories, investigators from universities and research institutions, and representatives from industrial and engineering research, and later the Department of Science and Research of the Council of National Defence was established. In Italy a national committee for co-operation of science and industry has been formed, and in France all these developments have been very closely watched with a view to action in the future.

Recent German proposals comprise an Institute for research in colloids at Frankfort, a Metal Research Institute, a new branch of the Textile Research Institute, and a Research Laboratory for investigations regarding food-stuffs.

LECTURE XII.

The Statistical Measurement of the Human Factor in Industry

By P. Sargant Florence, M.A., Ph.D.*

"Instead of using only comparative and superlative words and intellectual arguments, I have taken the course (as a specimen of the Political Arithmetick I have long aimed at) to express myself in terms of number, weight, or measure—to use only arguments of sense." Thus wrote Sir William Petty, in the middle of the seventeenth century, and, according to modern definitions, statistics do not differ in essence from this "arithmetick." M. Block calls statistics "La science de l'homme vivant en société en tant qu'elle peut ette exprime par les chiffres," while Von Mayr defines the study as "The systematic statement and explanation of actual events—on the basis of quantitative observation of aggregates."

The essence of the thing is the definite measurement introduced by the use of numbers. Before Petty's

* The author wishes to acknowledge his indebtedness to the United States Public Health Service. Some of the methods here described he was enabled to develop as scientific assistant supervising field investigations.

time the so-called statistics had been merely descriptions of facts, a general political survey, somewhat on the order of the statesman's year book of to-day. Even then, there are three distinctive points about this early method which are still observed to-day. The study dealt in large masses; the point of view was objective, that is to say, no preconceived views were introduced and as many of the facts as possible were considered and included; and the methods used were purely "observational," there were no special experiments or tests employed, and the facts constituted actual experiences.

In the middle of the eighteenth century a German clergyman, named Süssmilch, showed how convincing statistics could be in substantiating an hypothesis. He wrote a work purporting to prove the Divine ordering of the universe from a study of births, deaths, and the general increase in population. Süssmilch went into the subject very distinctly with preconceived views, but this fact does not prevent the method he used from being a powerful instrument in the objective search for truth. In this lecture I wish to set forth methods of using this instrument to throw light on the influence of the human factor in industry, and to study the way industrial workers behave in response to the requirements and the physical conditions under which they must work to-day.

The factory system inaugurated by the industrial revolution has required the workers' confinement during definite working hours amidst machinery involving continuous application, and has compelled the crowding of their homes into cities. The principle of this system is that authority in determining hours, speed and

conditions of work, and the type and disposal of the work done, is vested in the hands of the men owning the capital equipment. Those chiefly affected in their health—the actual workers—are driven to accept the dictates of the capital owners by the economic stimulus of poverty. They own no land or other material resources, and must depend entirely on the wage obtained in the factory, the amount of which, wherever possible, is determined by the amount of work performed. The result is an extreme likelihood of work being imposed beyond the powers of the workers; just as when those taxed are not represented in the taxing authority, taxation is liable to be too high for endurance. Nervous exasperation is also likely to be added to physical overstrain, since the product of the worker is taken away from him in exchange for his wages, and he has no further interest in the work of his hands. At any rate, all the instincts of workmanship that were fostered in the older handicraft system, are thwarted. Furthermore, when the workers do not produce the profit the capital owner expects, he is always at liberty to dismiss them. There is the possibility, therefore, that he may work them almost to death and then scrap them, replacing them in the factory with a younger generation.

Yet this system has enormously facilitated the statistical study of these evils. The very fact that there is one authority within the factory, makes for the order and uniformity, and the standardization of working conditions essential to numerical treatment. The investigator, when entering a factory, may know exactly how many hours are worked, between what times these hours run, at what average speed the work

is set, and he will find many thousands of workers living under precisely identical conditions. The continual increase in the size of factories, and in the standardization of their products and the technical processes through which they pass, make conditions more favourable for the statistician every year. It is an ill wind that blows no one any good!

Outside the factory, however, in the relations between factories, anarchy still reigns. The contrast between the ease with which things get done within the factory gates, and the difficulties and uncertainties where different business interests are involved, is perhaps the most striking feature of our present organisation. Except under the spur of war there is no central authority in industrial matters. Unemployment might exist in certain trades while men were over-employed in others, and general unemployment would be allowed to proceed without any interference, though it could perfectly well have been foreseen. The whole industry of the nation in fact depended upon a general optimism, and the confidence of one firm in another, and if once suspicions crept in, the whole structure was liable to panic and depression.

It is in the factory, rather than the national or international economic system, therefore, that we must look for scientific precision. Factory records alone present the uniformity of conditions necessary in measuring numerically the human factor in industry.

The difficulty has been that factory owners have failed to keep any records, or, if records are kept, they were not divulged. In the course of the nineteenth century things have gradually improved, partly owing to the action of the government stirred up by

the disclosures of industrial evils, partly owing to the manufacturer's own desire for efficiency. Most governments with an industrial democracy—sufficiently obstreperous—behind them, have held special inquiries into human working conditions, such as factory hours and wages, the productivity per head employed, the causes of strikes and the amount of unemployment; have undertaken the inspection of factories, and have passed laws instituting labour exchanges, insuring workers against sickness, and granting them compensation in case of accident. All this has made necessary on the part of the employer the keeping and the reporting of accurate information dealing with the conditions of production and the health of the worker. From the manufacturer's side, there has arisen spontaneously a movement culminating in scientific management, calling for a minute recording of almost every procedure in the factory. One aspect of this is the insistence on accurate cost accounts. "The object of costing is to make all wastes of labour as obvious as digging and filling a hole. Expert opinion regards the evidence as convincing that about one-third of all labour is wasted where adequate cost accounts are not maintained and used."[1]

Factory records may be defined as documents that register the actual business practice of the factory, and have not been written up specifically for the outside investigator. This is the same distinction that is made in historical studies between documents such as taxation inventories, judicial decisions in cases of disputes, etc., and the chronicles of contem-

[1] (Reconstruction Problems, No. 35; Ministry of Reconstruction.)

porary historians. In the one case it was in the truth of the records that their practical value lay at the time ; in the other, the records were written in the first instance for the very purpose of being investigated, and may easily exhibit "tendencies," or may even have been compiled definitely to lead astray. So in investigating factories, it is unwise to rely on the opinions of manufacturers or employees, expressed at the time, particularly when the person knows, or can guess, the object of the investigation. Apart altogether from the probable tendency to error one way or the other, there is bound to be a bias in one definite direction. Thus the manufacturer is likely to opine that shorter hours have done his employees no more good, and the employee *vice versâ*. Hence we must altogether reject such statistical compilations as those of the Industrial Conference Board of Boston, whose careful calculations and tabulations are with few exceptions all built on the sand of the employer's opinion. Where, in these same reports, documentary records are used, these by no means agree in their results with those based on opinions only.[1]

Factory records that will throw light on the human factor may be grouped in three main divisions : (1) Those describing the task before the worker ; that is to say, the nature of his work, the length during which, and the intensity at which, he must perform his work, and the physical and economic conditions prevailing in the factory where the work takes place. (2) Records describing the nature of the working force, the workers' physique, experience, age, sex, habits, and so on. (3)

[1] See review by Prof. R. E. Chaddock in American *Economic Review*, June, 1919, pp. 342–348.

Records noting the events taking place as the working force is " functioning " at its task in the factory. This division studies the inter-relation of Divisions 1 and 2, and describes what happens when the working force comes up against and rubs shoulders with the conditions and work of the factory.

The main purposes for which records of the human factor are worth keeping, are to insure the suitable assignment of work to the different types of individuals, so that monotony, ill will, and occupational diseases may be avoided; to prevent fatigue from overwork; and to avoid inefficiency and ill health from lack of hygienic care. The purpose of a full system of records comes to this—that, given a certain type of worker (Division 2), records of the factory at work (Division 3), will show how far the proper adjustments are made in the tasks imposed (Division 1), *i.e.*, in filling different jobs, in setting hours and intensity of work, and in arranging and planning the conditions of the factory.

(1) A census of the different kinds of work to be done was obtained at several factories that I visited, for the specific purpose of finding which jobs could be undertaken by women in order to release men for the war; and also in connection with the physical examination of applicants for employment, in order to place them in the most suitable type of work. Such a census would give the actual numbers employed at each kind of occupation, the degree of skill and training required, and what proportion of those occupied were women, or men, or minors. As a rule, the classification of the occupations was somewhat haphazard, and of little use in arriving at the physiological requirements. In one of these censuses, there-

tore, I took the separate groupings as I found them, but re-classified and systematized the whole tabulation. The general scheme which I adopted appears below. The factory was normally engaged on every type of brass ware, but was, at the time of the census, making munitions of war, particularly fuse parts. The same general types of occupations occur in every branch of the metal industry, and this list may be regarded as suitable, with slight modifications, to any engineering factory.

JOB ANALYSIS.

CODE NUMBERS FOR OCCUPATIONS AT BRASS FACTORY.

NOTES.—A, skilled; B, semi-skilled; C, semi-skilled and unskilled; D, unskilled.

00 ORGANIZATION—
A 01 Executives and Production Supervisors
A 02 Foremen
C 03 Watchman, Fire Patrol and Police
A 04 Timekeepers
A 05 Clerks
A 06 Stenographers
07
08
09

10 CRAFTS (STATIONARY)—
A 11 Toolmakers, Die Maker and Sinkers
A 12 Wheelwrights and Coopers
A 13 Patternmakers and Draftsmen
A 14 Grinders
A 15 Machinists
A 16 Blacksmiths, Tinsmiths and Machine Guard Dept.
17
18
19

20 CRAFTS (MOBILE)—
A 21 Repairmen, Motor Maintenance
A 22 Toolsetters
A 23 Oiler and Beltman
A 24 Painters
A 25 Carpenters
A 26 Millwrights
A 27 Lineman and Electrician
A 28 Building Trades: Masons, Bricklayers, Concrete and Steel Workers and Riggers
29 Pipe Fitters, Plumbers, Steamfitters

30 INSPECTION—
A 31 Inspectors and Gaugers
A 32 Checkers
A 33 Signal and Test
A 34 Chemists

35 HANDWORK—

C 36 Benchwork Assemblers
A 37 Solderers
A 38 Loaders
A 39 Lacquerers and Burnishers

40 BODYWORK—

CD 41 Labourers, Floormen and Utility
D 42 Truckers
C 43 Teamsters
D 44 Sweepers and Cleaning
D 45 Weighers
D 46 Packers
D 47 Stores
D 48 Coal and Ashmen
D 49 Errand Boys and Girls

50 HEAT TREAT—

A 51 Annealers and Muffles
B 52 (Hot) Forging Presses
A 53 Hardening, Brazers, Japanners, Bronzers
A 54 Electric Furnace
A 55 Stationary Firemen and Engineer
A 56 Extruded Press
BD 57 Furnace Tenders and Firemen
A 58 Moulders
A 59 Casters

60 WET TREAT—

D 61 Dippers
DC 62 Picklers
D 63 Drying Out
A 64 Platers
65 MACHINE TREAT—
A 66 Automatics
C 67 Hopper Machines
A 68 Rod Feeder
B 69 Cut and Carry Presses

70 MACHINE TREAT AND OPERATE—

71 Boilers, Rollers' Helpers, Rod Roll, Straighten Roll, and Draw Bench
D 72 Wire Workers and Wire Straighteners
D 73 Crane Trailer
D 74 Cabbage Machineman
D 75 Pointing Machine
D 76 Bull Block
D 77 Slitter and Shearman
78
79

80 MACHINE OPERATING—

C 81 Lathes, Hand-Screw Machines
AC 82 Lathe Machines (Miscellaneous): Clock, Engine, Tapping Turret, 4-Spindle Edger, Burring, Knurling
C 83 Milling
C 84 Power Press (not automatic)
D 85 Drills
D 86 Saws
B 87 Overhauling
88
89

90 MACHINE (MISCELLANEOUS)—

C 91 Blanking Press
C 92 Drawing Press
A 93 Dial Press
C 94 Spinning Machine
A 95 Hand Buff and Polishing
C 96 Footpress and Stamping
C 97 Elevator Man
B 98 Crane Operators
A 99 Jitney Driver and Chauffeurs

The list is arranged for use on the automatic tabulating machine, with code numbers ranging from 0 to 100. As far as possible every ten units is devoted to a separate class of work, and the open number left vacant for miscellaneous jobs. These classes fall into a general system as follows—

ROUTINE OCCUPATIONS—

35–39 HANDWORK, *e.g.*, Bench Assembly (Dexterous).
30–34 SENSE WORK, *e.g.*, Gauging (Dexterous).
05–06 BRAINWORK, *e.g.*, Clerks.
40–49 BODYWORK, *e.g.*, Labourers (Muscular).

MACHINEWORK—

96 Man-driven, *e.g.*, Foot-presses (Muscular).
97–99 Man-steered, *e.g.*, Automobiles.
80–89 Man-operated, *e.g.*, Lathes.
94–95 Man-fed, *e.g.*, Grinding-wheels.
91–93 Man-stocked, *e.g.*, Dial presses.

Man-tended—(Often Muscular).

50–64 Chemical Treatment, *e.g.*, Furnaces
65–79 Mechanical Treatment, *e.g.*, Automatics

ADAPTIVE OCCUPATIONS—

CRAFTS—

10–19 Stationary, *e.g.*, Toolmakers (Dexterous).
21–23 Circulating, *e.g.*, Toolsetters (Dexterous).
24–29 Structural, *e.g.*, Maintenance (Muscular).
03–04 POLICE, *e.g.*, Watchmen.
01–02 ADMINISTRATION, *e.g.*, Foremen.

My original purpose, since this list was to illustrate physiological requirements, was to make the main basis of classification the part of the body which was directly concerned in the work. This scheme, however, was only applicable in the case of routine occupations where, by extreme subdivision of labor, one part of the body only would be used. Hence routine occupations are differentiated from "adaptive" occu-

pations, and the parts of the body involved placed under the routine heading only. Where it is the machine that directly performs the work, sub-groups are formed according to the type of participation by the worker. In every group the code numbers are repeated and a well-known example is given, and wherever feasible, the group is assigned to some simple physiological type such as "muscular" or "dexterous."

This occupational census gives the different qualities of work to be done. As well as this, there is the simpler question of the various quantities of work imposed on the worker. The quantity of work may be measured by the duration of time in which work proceeds, coupled with the intensity at which it is performed. While duration of time is easily measured, intensity can usually only be recorded indirectly by noting the speed that was planned, and the type of incentive used to achieve this speed. Incentives differ in their effectiveness. Where a machine is automatic (code numbers 65–79), the planned speed is certain to be followed so long as the machinery is in working order. Where the human factor can control the speed of a machine, or where no machine at all is used, the attainment of the planned intensity will vary according to whether wages are paid on a time basis, at a straight piece rate, or on a progressively rising piece rate with heavy bonuses; according to how strongly the worker needs these wages, and according to the presence or absence of emotional stimuli. A phenomenon which in addition may further the attainment of a certain speed, is that of rhythm, since it is probable that certain speeds will be in conformity with the

worker's rhythm, and he may then pursue his work for a longer period without fatigue.

Most of these incentives can be measured numerically in terms of money, or by statistical devices such as the coefficient of dispersion. Even in case of the emotions, psychologists claim that, although the most effective advertisements cater to the emotions and not to the reason, the strength of the appeal of various advertisements can be graded empirically.

By indirect methods, therefore, we are enabled to measure the speeding up of the human factor almost as easily as we can measure his hours of labour. It is certainly worth trying, since all the effects produced through a reduction of hours may be entirely wiped out by planning an increased intensity of work, and one line of study is incomplete without the other.

The physical conditions of a factory that are important in affecting the human factor may be summarised as follows—

(1) Air: Temperature and Humidity; Ventilation and Room-space; Dust and Fumes Exhaust Systems; Smell.

(2) Light: Volume, Concentration, Glare.

(3) Noise: Volume, Irregularity, Vibration.

(4) Accident Hazards: Safety Devices; First Aid.

(5) Feeding: Sale of Food; Equipment; Service.

(6) Sanitation: Drinking Water; Rest Rooms; Baths.

It is of the utmost importance to be able to measure these physical conditions accurately and objectively. Thus, thermometers should be installed to record temperature and humidity, photometers to record the degree of light; instruments have also recently been

devised to measure noise. The accident hazard and the amount of room space per person may be measured statistically, while the nutritive value of the food provided, and the sanitary conditions, including dust, fumes and smell, can be analyzed in the laboratory. It is important to notice that many industrial practices that have been condemned as harmful to health, are so because they involve a complex of the conditions noted above. Thus the practice of working at night combines artificial light and a reversal of the feeding and sleeping habits of the worker.

(2) Records describing the nature of the working force are no less essential to industrial efficiency than records of the conditions in the factory, though it is often awkward for employers to obtain them, and employees may sometimes leave because they "refuse to be investigated." The solution might be found in the "devolution" of the recording function from the employing function, and the democratic representation of the workers on the recording body. This body would then employ medical officers to examine the applicants for employment, and to conduct periodical examinations of those that are admitted. All workers could be asked to fill in a questionaire somewhat as follows—

A. *Sex, Age, Race.*
B. *Experience.*—Date of entering Industry and Factory.
Former Occupations and Employers.
C. *Habits and Home Conditions*—

1. The amount and use of Earnings. Thrift. Food: Diet and Time of Meals. Stimulants: Alchohol and Tobacco. Sleep and Recreation: House Accommodation and Hygiene. Support of Dependants.

2. *Method and Length of Transit from Home to Work.*

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The filling in of Section D would have to be voluntary but if the worker were willing, psychological tests might be given to establish general intelligence and special aptitudes.

(3) Records of the factory at work consist of many well-known types; there are the records of production—the quantity of output, the consumption of power, the quality of output; there are records of casualties—accidents and sickness, etc., during work; there are records of the maintenance of the working force from day to day—absence and lateness and labour turnover, about which so much has been written during the last few years. We will consider each of these types of record in order.

(*a*) The quantity of output is generally measured daily per worker, in order to pay the correct piece wages, wherever the output is uniform and repetitive enough to admit of piece wages being calculated.[1]

To measure the working capacity of the workers, it is often important, however, to know the exact output each hour of the day. Great use has been made of such hourly records in the study of daily fatigue since hourly output curves,[2] often show a fall towards

[1] Where the output is not uniform and repetitive the efficiency of the worker, or a gang of workers, is measured by time spent per job. For methods of recording this, see Duncan, *The Principles of Industrial Management* (Appletons), Chapter XVI.

[2] See Florence, *Methods for Field Study of Industrial Fatigue*, U.S. Public Health Reports, Reprint 458; and *Use of Factory Statistics in the Investigation of Industrial Fatigue*, Columbia Studies whole No. 190 (P. & S. King), Chapters IV and XII.

the end of the day. Wherever an hourly measurement is easy—as where automatic registers are used on machines—manufacturers may be urged to make this count. Methods of overcoming certain difficulties involved are given below.

The quality of output became a particularly serious consideration for the manufacturer in the making of munitions, where the specifications are naturally very strictly enforced. The quality of output can be measured by the proportion of spoilt work to good work, but, of course, the proportion rejected may depend on the vigilance of the foreman at the time. Factories engaged on munitions usually have special inspectors to go through all the work produced. Unfortunately, since the inspection may take place several days a ter the article is produced, and in entirely different rooms, the human cause of imperfections (if any) is somewhat hard to trace, unless the time of production, and the name of the producer is noted on the output, or the output placed in special trays, etc. Here, again, a record of the hourly incidence of spoilt work would be of great value.

The power consumption is merely an indirect record of the quantity of output, and it refers only to output from machines that use power. In the analysis of occupations given above, this would include all the machine work (code numbers 65–99 with the exception of 96, "man-driven machine," and certain cases of 97–99, "man-steered"). Investigators should beware of generalizing too liberally from this single section of factory occupations. Almost all factories keep some sort of record of their power consumption in the interests of economy, and

a good many record this consumption on an automatically self-registering chart similar to the barometric charts seen in our public parks. This record gives the power consumption for every moment of the working day, and is in itself, therefore, a regular hourly curve, and proves very useful in investigating daily fatigue.

(*b*) Casualties may take the form of accidents or occupational disease, or merely temporary headaches, etc. Accidents involving more than one day of lost time, and certain specified diseases, must be reported to the government, and these records are kept very completely in all factories. Here, again, the hourly incidence of accidents has been used to investigate fatigue,[1] while the general accident rate per thousand employed per working year has been used to demonstrate the hazards of employing inexperienced or illiterate men, and to measure progress in accident prevention.[2] Latterly in the United States the growth of compensation laws and the enthusiasm over the "safety-first" movement has produced a great increase in accident statistics and the more accurate reporting of accidents at special first-aid stations in the factories.

(*c*) The maintenance of a standard working force is becoming an object of the greatest solicitude to the modern manufacturer. He knows the expenses involved in the "broken squad," in the uncertainties of casual labour, and, above all, in a high labour turn-

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[1] See Florence, *Use of Factory Statistics*, Chapters VI and XII. Some of the difficulties are outlined below.

[2] See *The Safety Movement in the Iron and Steel Industry*, U.S. Labour Department Bulletin, No. 234.

over. The amount of literature poured out in recent years on this subject of turnover is amazing when we consider that the whole conception of turnover was unknown four or five years ago. The Welfare Departments, or, as they are called in America, Employment or Personnel Departments, were indeed largely created to maintain the working force physically no less than morally.

Under the head of labour losses, the U.S. Shipping Board have issued a very acute analysis of the several factors involved, and of the logical methods of keeping this type of record.[1] First of all there is the loss due to the absences and lateness of members of the working force. The causes of such occurrences should be noted, particular attention being given to the proportion due to sickness and weariness as the possible result of factory labour, such unavoidable absenteeism being kept distinct from mere lack of discipline.[2] The costs of labour turnover, as generally understood, then fall under two heads: the expenses due to *unforeseen* variations in the standard working force, and the expenses due to the necessity of replacing the men who have left. Turnover should be regarded as the proportion of men leaving a factory that have to be replaced to keep up the standard force. It is a great mistake to calculate turnover as though synonymous with the proportion of men leaving the factory, without

[1] Special Bulletin of the Industrial Relations Division, Emergency Shipping Corporation, Philadelphia.

[2] For a standard calculation of the proportion of sickness among workers, see Florence, *Use of Factory Statistics*, pages 81 and 82. For methods of recording individual absences, etc., see Duncan, *The Principles of Industrial Management* (Appleton & Co.), Chapter XVI.

regard to whether they left by authority of the management or not. Where a factory is reducing its staff deliberately, owing, let us say, to a reduction in orders, it is ridiculous to regard the large proportion of "exits" as a sign of inefficiency and labour wastage. Unfortunately this is the method adopted by the United States Labour Department, and recommended officially throughout America.[1] In connection with the turnover in and out of the factory, many factories have systems whereby men are transferred from department to department within the factory. This may often serve as a safety-valve against the high turnover, and for the investigator is a useful indication of the relative onus of the jobs in different departments. Even if transfers are not granted very freely on medical grounds, it is most valuable to have a record of the requests made for transfers by the men, and the proportion of these in the different divisions of the factory.

This completes the list of factory records that can throw light on the human factor and its importance in industry. The next point to be considered is how much light these records throw, and how far this light may not be sharpened. We are faced with two separate questions: (1) How many of the records of each type vary proportionately with variations in the working capacity and goodwill of the human factor? Should we select certain parts of the records and not others? (2) Do these records that we select vary proportionately with variations in working capacity, goodwill, etc., SOLELY, or do they vary with variations in other

[1] See Conference of Employment Managers, Bulletin 227 of the U.S. Bureau of Labour Statistics.

factors besides the human factor? These other variations may be mere chance fluctuations, not a regular state of the human factor in industry, and in this case they will be liable to cancel out in the long run by averaging. For instance, the output for a certain day may fluctuate as the result of unusual bad temper on the part of the foreman, but by averaging many days, we shall obtain the effect of his normal emotional state. Where the disturbing variations are a regular condition affecting the records used, we must eliminate them in various ways according to the type of record. Some examples we will give below.[1]

The main factor competing with the human being for expression in the records of production is the machine. The importance of the mechanical factor will depend, of course, on the type of work. Referring to our analysis above, we can see that speeding of the machine will directly affect the output in the "man-tended" types (Code Nos. 50–79), and to a certain extent in the "man-fed" and "man-stocked" types (Code Nos. 91–95). If knowledge is desired of the human factor, records must not be selected from these types. But even when man-operated machines only are selected, the amount of output in any hour or day may be the result of a shortage of stock or power, or a breakdown in the machines, and the manufacturer should make careful note of these occurrences. If records are being taken of hourly output, some such form as the following may be used, so that the time lost in breakdown, etc., may

[1] For a full discussion of the factors involved, so far as the measurement of fatigue is concerned, see Florence, *Use of Factory Statistics*, Chapters IV to VIII.

be eliminated by correction. Absence of stock will hold up the output in handwork, of course, just as effectively as the output from machines.

Hour.	Gross Output.	Time wasted Involuntarily.	Corrected Output.	Time wasted Willingly.
9–10	20 boxes	9.30–35— Machine Stoppage	$20 \times \frac{60}{55} = 21\frac{9}{11}$	Rest— 9.10–9.20
10–11	15 boxes	10.40–11— Lack of Materials	$15 \times \frac{60}{40} = 22\frac{1}{2}$	Leave Room 10.20–10.25
11–12	12 boxes	Call to Office, 11–40	$12 \times \frac{60}{40} = 18$	Talk— 11.30–11.35

The human factor may be masked in accident records also, by the occurrence of a large number of accidents due to all kinds of material circumstances, such as the explosion of chemicals, wheels left unguarded, slippery floors, etc. And just as types of work should be distinguished according to the participation in varying degrees of the human factor, so types of accidents may be graded according to the degree of responsibility of the human factor in their occurrence. I outlined some such scheme in a report to the British Association for the Advancement of Science,[1] and experience has shown that the greater number of factory accidents fall into the more "humanly circumstanced" grades. However, manufacturers can test the truth of this assertion for themselves by using the following questionaire, which is adapted for twelve code numbers on the automatic tabulating machine.

[1] Second Interim Report of the Committee on Fatigue from the Economic Standpoint. The scheme is summarised in Florence, *Use of Factory Statistics*, pages 62 and 63.

CLASSIFICATION OF ACCIDENTS.

For Twelve Code Numbers.

Question on Slip—

What Caused Accident? Check *one* of following causes—

1. Flying or falling object ....
2. Worker got caught ....
3. Worker fell, cut, knocked himself ....
4. Object dropped by worker ....
5. Other cause (describe) ....

Was Equipment Defective? (Including Working Clothes)

Was Worker on Regular Work? ....

Code Numbers—

(1)	Cause 1.	Equipment defective (worker on regular work or not).
(2)	,, 2.	,, ,, ,, ,, ,,
(3)	,, 3.	,, ,, ,, ,, ,,
(4)	Cause 1.	Worker NOT on regular work. Equipment sound.
(5)	,, 2.	,, ,, ,, ,, ,,
(6)	,, 3.	,, ,, ,, ,, ,,
(7)	,, 4.	,, ,, ,, ,, ,,
(8)	Cause 1.	Worker on regular work. Equipmt., sound or unsound
(9)	,, 2.	,, ,, ,, ,, ,, ,,
(10)	,, 3.	,, ,, ,, ,, ,, ,,
(11)	,, 4.	,, ,, ,, ,, ,, ,,
(12)	Cause 5,	and all unassignable cases.

In accordance with the scheme referred to above, it is assumed that the causes of the accident where the human factor had least weight is where the material acted unusually (as in the case of a flying or falling object), and that it had more weight where the worker got caught, or fell, cut, or knocked himself, and most weight where the object did the injury, but was dropped by the worker himself. If the equipment was defective and the worker was not on regular work, it makes him the less responsible, so that code number 1 signifies an accident least "expressive" of the human factor, and code number 11 an accident most expressive of this factor. In the intervening code numbers 2–10, the human factor is gradually increasing in weight.

To measure the human factor most accurately through accident records, only the higher grades of accidents may be selected, but even when this selection is made, there are factors to be eliminated which disturb the measurement. The number of accidents occurring to any given number of men at one time rather than another will obviously depend very largely on the amount of work they are doing, and therefore, before we can measure the liability of the human factor to accidents, we must eliminate fluctuations due merely to the increase or decrease of the physical hazards. If a group of men pass certain dangerous points at one time twice as frequently as before, the doubling of their accidents gives no indication that these men are more careless or more tired. It is necessary therefore to state the number of accidents of any given group per unit of their output, if pitfalls are to be avoided.[1]

In certain cases the manufacturer may want to analyze "the human factor" more exactly. Thus, where he finds the output lower than he expected, he may want to know whether this is due to human physiology, *e.g.*, fatigue; or to human will, *e.g.*, ca' canny. If he wishes to keep these two phenomena distinct, he must eliminate first the one and then the other. It is easy to discover cases where output is wilfully limited; an exactly similar total per day is likely to appear for worker after worker and day after day. At any rate, when the amounts of the individual daily outputs are plotted, a curve will be obtained differing radically from the curve of normal probability.

[1] For a review of the development of a scientific method, see U.S. Public Health Service Bulletin, No. 106, *Studies in Industrial Fatigue*.

Instead of the average figure being most frequent, and plus and minus deviations from this average decreasing in frequency as they get larger, we get a "skew" curve with the highest output the most frequent—this highest output being the "stint" which is never willingly exceeded.

It is not contended that the records on file at a progressive factory give a complete picture of the worker's capacities and behaviour. In fact, those actually on the pay roll of a factory may be regarded as survivors of a struggle for existence, and if we confine ourselves to factory records we would be ignoring those that "went under." When we know the huge numbers that leave a factory every year and swell the turnover, and when we know that the average age of workers in the factory is often little above thirty, the number of unfit and unemployable seems by no means negligible. What is required to supplement the records in the factory is the history over long periods of selected individual workers. Their output, sickness, etc., should be followed up not merely throughout the cycle of day and week where work is balanced by rest, but throughout months and years where our present industrial system gives no respite. Then only shall we be able to gauge the force of a fatigue that is continually accumulating until the worker quite ceases to be a factor in the industrial situation.

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